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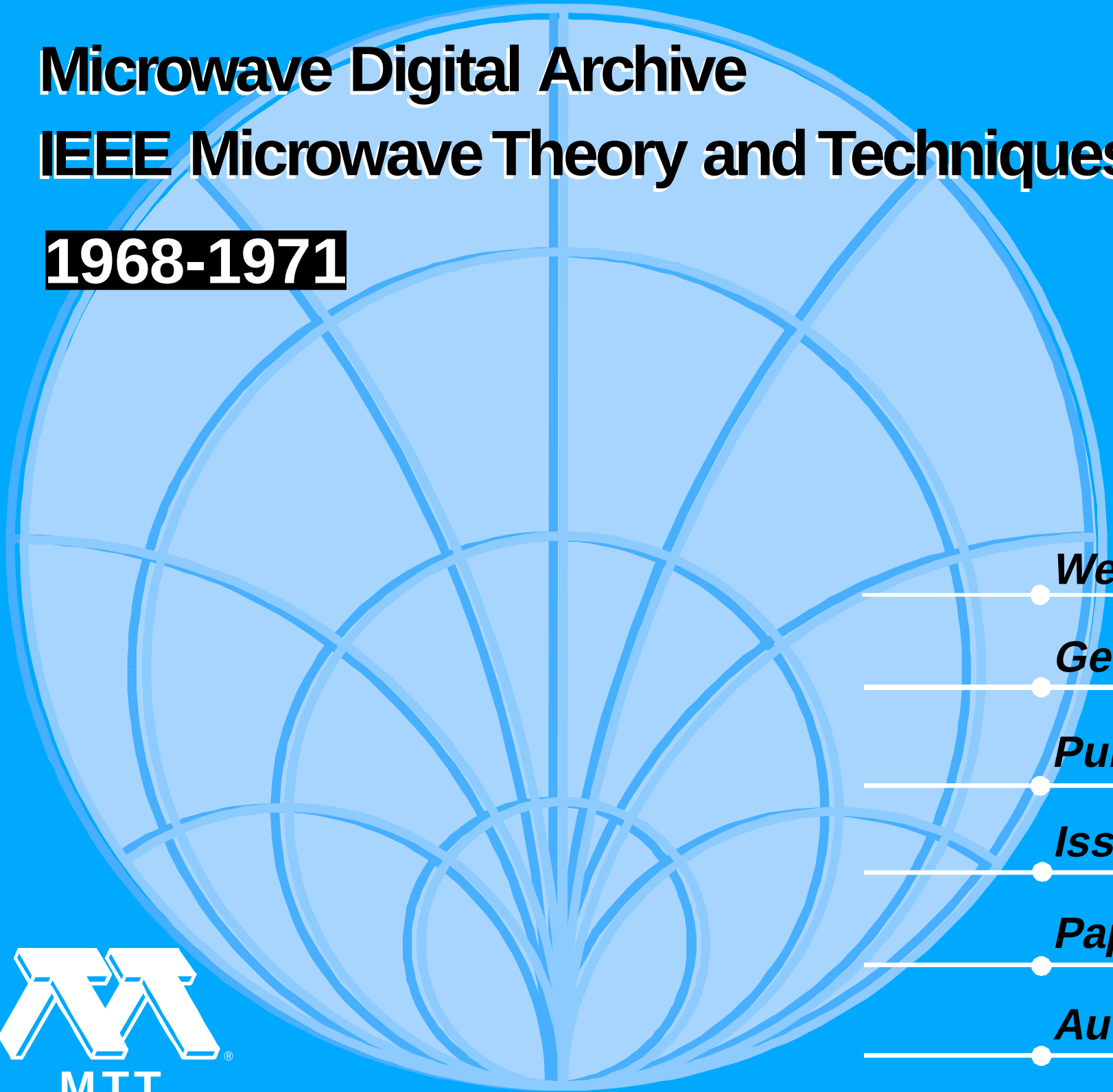
IEEE Microwave Theory and Techniques Society

1968-1971



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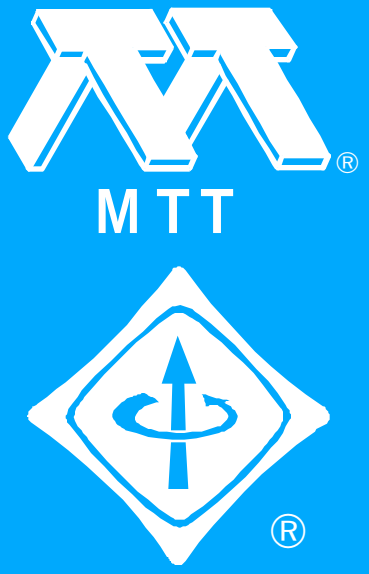

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ACKNOWLEDGMENTS

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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Getting Started

INTRODUCTION

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In many instances, we refer to the “menu bar”, shown here for reference.

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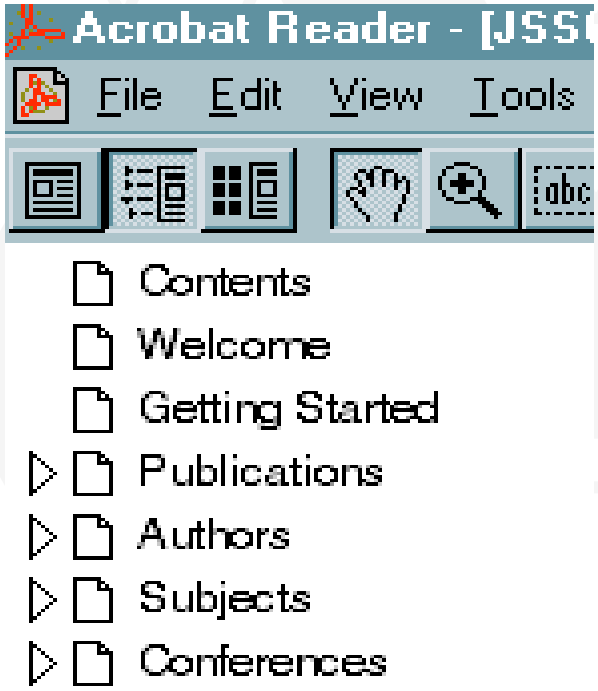
In addition to links, you can navigate through the Electronic Guide using Bookmarks. If they are not already visible, choose View > Bookmarks and Page from the menu bar or press the “Display Page and Bookmarks” button on the tool bar. A panel opens on the left side of the screen displaying Bookmarks in a hierarchy.



Each Bookmark corresponds to a page in the Guide. Click on the text in a Bookmark to go to that page.

Entries with lower level Bookmarks show an arrowhead, pointing down when subordinate Bookmarks are visible, pointing right when hidden. To view subordinate Bookmarks, click on the arrowhead. To hide them, click on the arrowhead again. Dragging the right margin of the bookmark panel resizes it.

PRINTING ARTICLES

Articles may have text outside normal print-area defaults. We recommend selecting “Shrink to Fit” in the print menu (File > Print) to capture the complete image for your printout. This setting will become your new default.

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To copy graphics to the Clipboard, choose Tools > Select Graphics from the menu bar. The cursor changes to the cross-hair icon.

Drag a rectangle around the graphic to select it. When you release the mouse button, the selected graphic is highlighted.

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NAVIGATION BUTTONS

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

Section Map

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.

Next Page button

Click to advance to the next page in the section.

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Click to go back to the previous page in the section. The first and last pages of a section show only one button.

The Page Up and Page Down keys perform the same functions.

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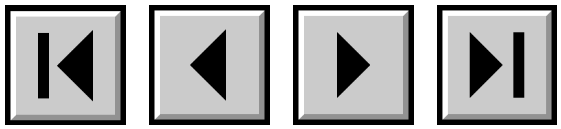

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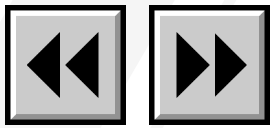

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SEARCHING

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Choosing the Search button or Search menu item (Tools > Search), selecting the Query item, opens a dialog box from which you can access the more powerful full-text search engine (if you installed Acrobat with the Search plug-in from this CD-ROM). Its dialog box is shown on the next page.

Typing a term in the text box at the top of the Search dialog box and pressing the “Search” button causes a full-text search of all words in the body of papers in the collection. Entering a term in one or more of the fixed fields (Title, Author, Subject or Keywords) will cause a search for hits in only those fields.

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If you are not finding files you think should show in the results list, Acrobat may not be attached to the correct index file. To check, press the “Indexes...” button for a list of available indexes. If this title is not listed, press the “Add...” button and look in the root directory of the CD-ROM for a file called “index.pdx”. Click on that file to add it to the list. If none exists, this title was not indexed.

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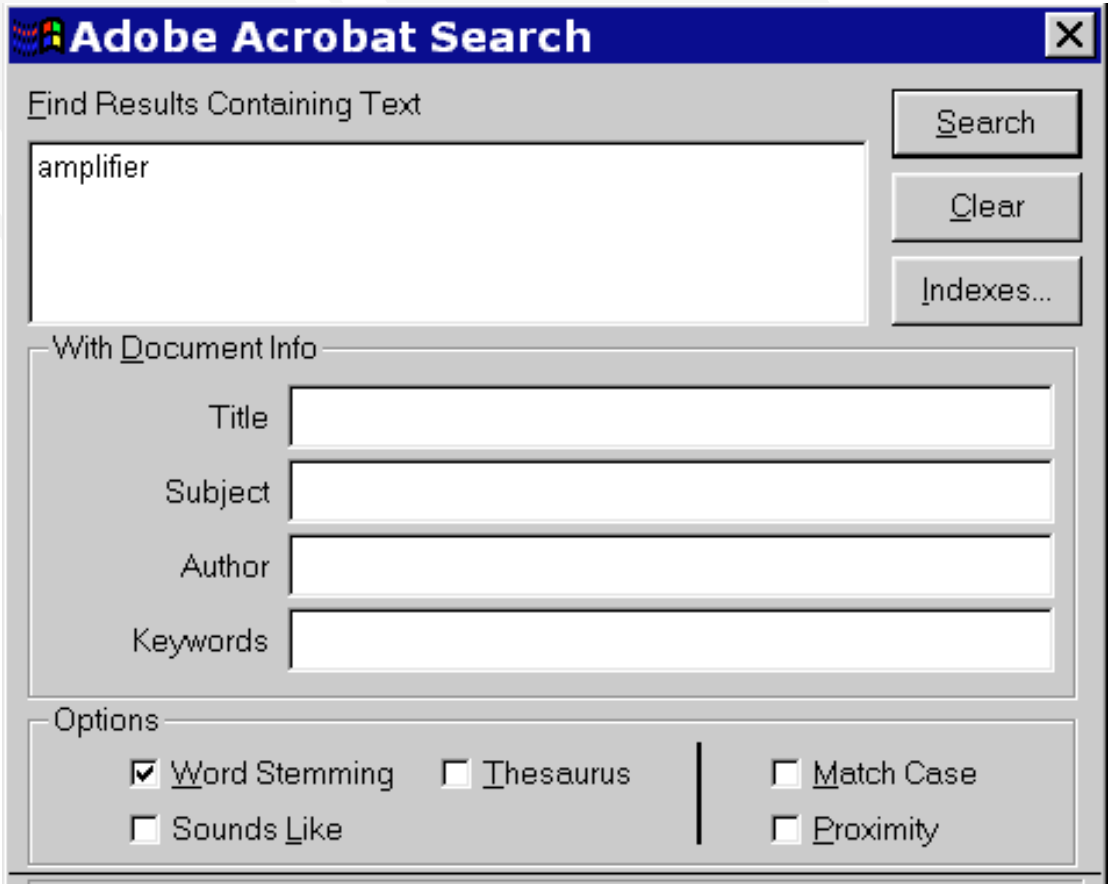

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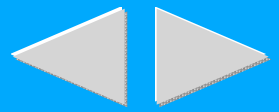

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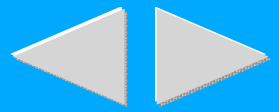

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- Equivalent Circuit of the Bolometer Detector (Comment)

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- A New Reciprocal Phaser for Use at Millimeter Wavelengths (Correspondence)

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Abstracts

Two Examples of "Confluence" in Periodic Slow Wave Structures

D.R. McDiarmid and G.B. Walker. "Two Examples of "Confluence" in Periodic Slow Wave Structures." 1968 Transactions on Microwave Theory and Techniques 16.1 (Jan. 1968 [T-MTT]): 2-6.

The properties that result from the elimination of a stop-band of a lossless periodic slow wave structure are discussed. For two particular structures, it is shown that theory predicts a nonzero group velocity at the point of confluence of the two passbands. This confluence is desirable for linear accelerator structures operating at the /spl pi/-mode since it produces increased mode separation. Certain characteristics of zero and /spl pi/-mode confluence are also discussed.

Abstracts

Coupling Between Dissimilar Waveguides

E.H. Kopp and R.S. Elliott. "Coupling Between Dissimilar Waveguides." 1968 Transactions on Microwave Theory and Techniques 16.1 (Jan. 1968 [T-MTT]): 6-11.

Investigators have used coupled-mode theory to analyze the coupling between identical waveguides; in such cases the coupling coefficients are found to be identical. If the waveguides differ, the coupling coefficients are asymmetrical and difficult to evaluate by strictly theoretical methods. An alternate approach to this case is considered in the present work. A pair of coupled-mode equations is first developed from a consideration of the permissible fields within the device. This clarifies the relationship between the coupled-mode theory and the more general classical electromagnetic theory by giving a careful definition of the coupled and the normal modes of a coupled structure. It is shown that the coupled-mode equations are an exact representation of the waveguide fields, although for engineering purposes it is often convenient to use approximate values of the coefficients of these equations. The mutual coupling coefficients are obtained from a two transmission-line model of the structure, with the actual coupling mechanism represented by a mutual impedance common to the two lines. For dissimilar lines, the ratio of the coupling coefficients is found to be equat to the ratio of the characteristic impedances. For the cases considered, this is the same as the ratio of the propagation constants of the uncoupled lines, which permits the coupling coefficients to be determined from relatively simple measurements. The adequacy of the theory has been confirmed by a series of experiments.

Abstracts

Guided Waves in Moving Dispersive Media Part I: Nonrelativistic Velocities

H. Berger and J.W.E. Griemsmann. "Guided Waves in Moving Dispersive Media Part I: Nonrelativistic Velocities." 1968 Transactions on Microwave Theory and Techniques 16.1 (Jan. 1968 [T-MTT]): 11-16.

A theoretical examination is presented of the influence of a dispersive medium on the time-harmonic TE and TM modal field structure of eletromagnetic waves in a cylindrical waveguide of arbitrary cross section when the medium is in relative motion with respect to the waveguide walls. The modal field structure observed both in the reference frame F' attached to the medium, and in the reference frame F attached to the waveguide walls, is determined in closed form. The results presented for the modal fields observed in F are valid when the medium moves with nourelativistic speed v. Contact is made with the standard relativistic discussion of TEM waves in slowly moving dispersive media involving the Fresnel drag coefficient, and it is noted that the customary restrictions on v for numerical accaracy of the results can be inadequate. The theory is applied to two special cases. The nonreciprocal phase shift exhibited by a waveguide filled with moving media is also discussed.

Abstracts

Guided Waves in Moving Dispersive Media Part II: Relativistic Velocities

H. Berger and J.W.E. Griemsmann. "Guided Waves in Moving Dispersive Media Part II: Relativistic Velocities." 1968 Transactions on Microwave Theory and Techniques 16.1 (Jan. 1968 [T-MTT]): 16-20.

The detailed modal field structure has been determined for electromagnetic waves propagating in a uniform cylindrical lossless waveguide of arbitrary cross section filled with a moving medium. The medium is assumed to be homogeneous, isotropic, and nondissipative, but may be dispersive. It moves uniformly, with a constant speed v, parllel to the axis of the waveguide. The solutions obtained are exact closed-form functions of the space variables, time, modal wave frequency, and propagation factor, and they hold for any value of the magnitude of v, from zero up to the speed of light in vacuum. The electromagnetic power flow in the waveguide is investigated and shown to display characteristics that differ considerably from those associated with the stationary medium case. The general theory is applied to several types of moving media, including nondispersive media and the idealized low-temperature plasma.

Abstracts

Perturbation Measurement of Transverse R/Q in Iris-Loaded Waveguides

H. Hahn and H.J. Halama. "Perturbation Measurement of Transverse R/Q in Iris-Loaded Waveguides." 1968 Transactions on Microwave Theory and Techniques 16.1 (Jan. 1968 [T-MTT]): 20-29.

The measurement of transverse R/Q in iris-loaded waveguides by perturbation techniques is described. The underlying pertrurbation theory for resonant cavities is reviewed, and formulas for metallic needles, a sapphire rod, and a teflon bead are given, A calibration of the perturbing objects in TM/sub 010/ and TM/sub 110/ cavities shows good agreement with theory. Conventional oscillator and transmission methods are compared, and a systematic error of the oscillator method is explained. A more sensitive null method is described. A definition of the transverse R/Q is given, from which it follows that the knowledge of the longitudinal electric field component is sufficient to determine the deflecting properties of a structure. The accuracy of perturbation measurements was tested on a cavity for which the R/Q was known from computer calculations and deflection tests. It was found that the various values agree to within 20 percent. Perturbation measurements of deflectors with small coupling holes showed the theoretically predicted interaction parameters. Values close to 2.2 k/spl Omega/ /m at 2.856 GHz were measured on a 2/3 /spl pi/ wave structure with about a 2-cm beam hole.

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Diode SPDT Switching at High Power with Octave Microwave Bandwidth

J.F. White and K.E. Mortenson. "Diode SPDT Switching at High Power with Octave Microwave Bandwidth." 1968 Transactions on Microwave Theory and Techniques 16.1 (Jan. 1968 [T-MTT]): 30-36.

A SPDT diode switch was designed for use at 1-2 GHz, having 1.3 dB maximum insertion loss and 43 dB minimum isolation. It was tested to a burnout peak power of 6 kW at 1 μs pulse length and 0.001 duty cycle. The switch configuration uses a transmission-line tee with diodes mounted in shunt with the line for convenient mechanical access and efficient heat removal. This configuration is examined to optimize both the transmission and isolation properties over an octave bandwidth. Special attention is given to the procedures for resonantly tuning the diode capacity and inductance parameters. A design criterion for a circuit that minimizes ohmic losses contributed by the diodes is also presented.

Abstracts

Plasma Diagnostics with a Microwave Fabry-Perot Resonator

R.J. Chaffin and J.B. Beyer. "Plasma Diagnostics with a Microwave Fabry-Perot Resonator." 1968 Transactions on Microwave Theory and Techniques 16.1 (Jan. 1968 [T-MTT]): 37-45.

Plasma diagnostics with a confocal spherical mirror Fabry-Perot resonator are examined. The diagnostic equations are presented and experimentally verified. The measurable ranges of electron densities and collision frequencies are treated both theoretically and by example. A brief background of the theory of the resonator is summarized (with references) from the literature. A perturbational technique for measuring collision frequency, or Q change, through the variation of a resonator's transmission coefficient at resonance (for a general resonator) is derived, and the results experimentally verified. This technique could be a powerful diagnostic tool and is shown to have certain advantages under noisy conditions. This type of resonator is simple and inexpensive to construct, easy to align, and gives very good diagnostic results.

Abstracts

A Frequency Transformation for Commensurate Transmission-Line Networks (Correction)

E.G. Cristal. "A Frequency Transformation for Commensurate Transmission-Line Networks (Correction)." 1968 Transactions on Microwave Theory and Techniques 16.1 (Jan. 1968 [T-MTT]): 45-45.

E. G. Cristal, author of the above paper, which appeared on pp. 348-357 of the June, 1967, issue of this Transactions, has called the following to the attention of the Editor.

Abstracts

Bandwidth of a Balanced Micropill-Diode Parametric Amplifier (Correspondence)

C.S. Aitchison, R. Davies and C.D. Payne. "Bandwidth of a Balanced Micropill-Diode Parametric Amplifier (Correspondence)." 1968 Transactions on Microwave Theory and Techniques 16.1 (Jan. 1968 [T-MTT]): 46-47.

The theoretical G/sup ½/B product available from a varactor parametric amplifier is calculated in terms of the junction parameters, and it is shown that there is a maximnm value occurring at an optimum idling frequency. An amplifier design which, using two varaetors, enables this optimum G/sup ½/B value to be obtained is then described. A comparison is made between theory and practice.

Abstracts

X-Band Traveling Wave Maser (Correspondence)

S.M. Petty and R.C. Clauss. "X-Band Traveling Wave Maser (Correspondence)." 1968 Transactions on Microwave Theory and Techniques 16.1 (Jan. 1968 [T-MTT]): 47-48.

A traveling wave maser (TWM) has been constructed for use at 8448 MHz. It provides a net gain of 41.5 dB when installed in a closed-cycle helium refrigerator operating at 4.4°K. The maser provides more than 30 dB net gain over a tunable range of 140 MHz. An equivalent input noise temperatrrre of approxi-mately18°K has been measured.

Abstracts

The Analysis of Lossless Transmission-Line Matching Systems in Terms of Real Functions (Correspondence)

C.S. Gledhill. "The Analysis of Lossless Transmission-Line Matching Systems in Terms of Real Functions (Correspondence)." 1968 Transactions on Microwave Theory and Techniques 16.1 (Jan. 1968 [T-MTT]): 49-50.

Recent papers have defined the unit real (UR) function and have discussed the synthesis of given UR functions of input reflection coefficient rho(z), where z = e/sup-j(f /f0)pi/ and is the frequency at which a line is lambda/4 long, into circuits consisting of commensurable lossless transmission lines with resistive termination.

Abstracts

Millimeter Wavelength Diplexing Filters Utilizing Circular Te/sub 011/ Mode Resonators (Correspondence)

R.D. Standley. "Millimeter Wavelength Diplexing Filters Utilizing Circular Te/sub 011/ Mode Resonators (Correspondence)." 1968 Transactions on Microwave Theory and Techniques 16.1 (Jan. 1968 [T-MTT]): 50-51.

This correspondence details the procedure for designing a diplexing filter with rectangular waveguide inputs and outputs using circular TE/sub 011/ mode resonators, as shown in Fig. 1. The advantage of using TE/sub 011/ mode resonators in the otherwise conventional arrangement lies in their high intrinsic Q characteristic. The latter is, of course, necessary in realizing Iow-loss, high loaded Q diplexers. Four such diplexers were developed for use as local oscillator injection filters to mixers at a center frequency 50.4 GHz. The signal band of interest was 51.7±0.3 GHz. The experimental models had a 3 dB bandwidth of 50 GHz and midband insertion loss of 1.5 dB. Figs. 2 and 3 show typical frequency responses observed at the various ports. Correlation between theory and experiment was good.

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Broadband Tapered-Line Phase Shift Networks (Correspondence)

C.P. Tresselt. "Broadband Tapered-Line Phase Shift Networks (Correspondence)." 1968 Transactions on Microwave Theory and Techniques 16.1 (Jan. 1968 [T-MTT]): 51-52.

It is presently possible to utilize cascaded quarter-wavelength coupled-line sections in an allpass configuration to provide constant phase shift relative to the phase of a properly chosen length of TEM line over multioctave bandwidths. A fairly complete bibliography of work in this field is given by Shelton and Mosko. Unfortunately, the spread in coupling values between adjacent sections is large enough to produce significant reactive discontinuities in practical TEM line geometries, adversely affecting VSWR and phase accuracy of the device. The purpose of this corrrespondence is to describe a design which considerably alleviates the effect by employing coupling which is continuously tapered through the length of the device.

Abstracts

Plane Dielectric-Coated Conductor Surface Waveguide Corners (Correspondence)

W.L. Stutzman. "Plane Dielectric-Coated Conductor Surface Waveguide Corners (Correspondence)." 1968 Transactions on Microwave Theory and Techniques 16.1 (Jan. 1968 [T-MTT]): 52-53.

Techniques for guiding energy around a corner in the plane of a plane dielectric coated conductor surface waveguide are discussed. Design is divided into two classes: large and small angle corners. The power loss for both cases is examined.

Abstracts

Calculating Isolation in Lossy TEM Mode Couplers (Comments)

G.F. Ross. "Calculating Isolation in Lossy TEM Mode Couplers (Comments)." 1968 Transactions on Microwave Theory and Techniques 16.1 (Jan. 1968 [T-MTT]): 53-54.

In a recent correspondence Kutzrok presents an approximate solution for determining the isolation between biconjugate ports of a microstrip directional coupler. Implicit in his solution is the fact that the interconnecting transmission lines between nodes of the coupler satisfy the Heaviside condition, that is, R/L= G/C=a.

Abstracts

Magnetostriction Effects on Ferrite Material Parameters of Importance in Remanence Devices (Correspondence)

R. Epstein, R. Germann, J. Sohn and D. Temme. "Magnetostriction Effects on Ferrite Material Parameters of Importance in Remanence Devices (Correspondence)." 1968 Transactions on Microwave Theory and Techniques 16.1 (Jan. 1968 [T-MTT]): 54-55.

Stresses have been shown to have pronounced effects on the shapes of the hysteresis loops of magnetostrictive garnets and nickel ferrites. These stresses, which can be induced by the mechanical pressure of the ferrite mount or by the machining of the ferrite, may appreciably alter other basic material parameters. This correspondence reports additional data obtained on some magnetostriction effects pertinent to remanent device applications.

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An Explicit Derivation of the Relationships Between the Parameters of an Interdigital Structure and the Equivalent Transmission-Line Cascade (Corrections)

H.J. Riblet. "An Explicit Derivation of the Relationships Between the Parameters of an Interdigital Structure and the Equivalent Transmission-Line Cascade (Corrections)." 1968 Transactions on Microwave Theory and Techniques 16.1 (Jan. 1968 [T-MTT]): 55-55.

The author of the above wishes to thank G. R. Hoffman of the Laboratorium voor Electromagnetisme en Acustica, University of Ghent, Belgium, for pointing out that matrix equation (1) might be written more accurately and clearly as:

Abstracts

The Complex Permittivity of Some Cork Composition Materials from 10 to 10,000 MHz (Correspondence)

W. Rueggeberg. "The Complex Permittivity of Some Cork Composition Materials from 10 to 10,000 MHz (Correspondence)." 1968 Transactions on Microwave Theory and Techniques 16.1 (Jan. 1968 [T-MTT]): 55-57.

The electrical characteristics of two cork composition grades have heen evaluated at room temperature from 10 to 10 000 MHz through measurement of dielectric constant and loss tangent at appropriately spaced frequency intervals. The dispersive behavior of dielectric constant for both materials is accompanied by a typical rise of loss tangent, occurring in this investigation in the vicinity of 200 MHz. The experimental results are presented as continuous functions of frequency, and they reveal clearly the electrical behavior of the test materials over the specified range of frequencies.

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Nonsymmetrical Coupled Lines of Reentrant Cross Section (Correction)

E.G. Cristal. "Nonsymmetrical Coupled Lines of Reentrant Cross Section (Correction)." 1968 Transactions on Microwave Theory and Techniques 16.1 (Jan. 1968 [T-MTT]): 57-57.

The author of the above correspondence has brought the following to the attention of the Editor.

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Contributors (Jan. 1968 [T-MTT])

H. Berger, J.B. Beyer, R.J. Chaffin, R.S. Elliott, J.W.E. Griemsmann, H. Hahn, H.J. Halama, E.H. Kopp, D.R. McDiarmid, K.E. Mortenson, G.B. Walker and J.F. White. "Contributors (Jan. 1968 [T-MTT])." 1968 Transactions on Microwave Theory and Techniques 16.1 (Jan. 1968 [T-MTT]): 57-58.

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"Membership Application (Jan. 1968 [T-MTT])." 1968 Transactions on Microwave Theory and Techniques 16.1 (Jan. 1968 [T-MTT]): 59-59.

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Microwave Allpass Networks--Part I

S.O. Scanlan and J.D. Rhodes. "Microwave Allpass Networks--Part I." 1968 Transactions on Microwave Theory and Techniques 19.2 (Feb. 1968 [T-MTT]): 62-72.

In this paper it is shown that any arbitrary delay characteristic of a commensurate microwave network, which supports a TEM mode of propagation, may be realized by means of a transformerless, coupled-line network within an arbitrary additive constant. The realization procedure presented is based upon the synthesis of microwave C-type and D-type allpass sections.

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Microwave Allpass Networks--Part II

S.O. Scanlan and J.D. Rhodes. "Microwave Allpass Networks--Part II." 1968 Transactions on Microwave Theory and Techniques 19.2 (Feb. 1968 [T-MTT]): 72-79.

In this paper synthesis procedures are developed for the direct realization of a complete microwave allpass network without the reduction of the network to cascades of C- and D-type sections which include interdigital line structures. The application of microwave allpass networks to the phase correction of conventional microwave filters and to the construction of delay networks with linear delay characteristics is also presented.

Abstracts

Synthesis of Symmetrical Branch-Guide Directional Couplers

R. Levy and L.F. Lind. "Synthesis of Symmetrical Branch-Guide Directional Couplers." 1968 Transactions on Microwave Theory and Techniques 19.2 (Feb. 1968 [T-MTT]): 80-89.

A synthesis procedure is described for the design of branch-guide directional couplers which gives results showing a significant improvement over previous approximate methods. The synthesis technique adopted gives exact Butterworth characteristics and almost exact Chebyshev equal-ripple characteristics, the deviations in the latter case being so small that in most practical cases they may be neglected. The design of branch-guide couplers for bandwidths of greater than one octave is demonstrated. The design information for a large number of cases of practical interest is presented in tabular form, and experimental results for several branch-guide couplers constructed in waveguide and in stripline are in good agreement with the theory. The technique could prove valuable in the design of microminiature stripline hybrids and couplers.

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Calibrated Reflection Coefficient Standards for the Circular TE/sub 01/ Mode

K.S. Champlin, G.H. Glover, J.D. Holm and N.A. Patrin. "Calibrated Reflection Coefficient Standards for the Circular TE/sub 01/ Mode." 1968 Transactions on Microwave Theory and Techniques 19.2 (Feb. 1968 [T-MTT]): 90-94.

This paper describes simple reflection coefficient standards for use with the circular TE/sub 01/ mode. They consist of circular irises inserted directly into the flange connection of a "matched" termination. The reflection coefficient of an iris is formulated exactly and then evaluated to any desired degree of approximation with a digital computer. The results of a 30-mode approximation are presented and shown to agree with 24 GHz measurements of the modulus and phase of /spl rho/ of 7 irises to within about 0.008 relative units and 0.02 radians, respectively.

Abstracts

The Application of Z-Transform Techniques the Analysis of Paraxial Ray Propagation in Beam Waveguides

J.C. Daly. "The Application of Z-Transform Techniques the Analysis of Paraxial Ray Propagation in Beam Waveguides." 1968 Transactions on Microwave Theory and Techniques 19.2 (Feb. 1968 [T-MTT]): 95-98.

The Z-transform technique has been applied to the effect of lateral lens displacements on the propagation of paraxial rays in a lens guide. The Z transform of the ray displacement from the guide axis is obtained and techniques for obtaining the ray displacement from its Z transform are outlined. The property of the transform that determines the stability of the ray in the guide is given. To illustrate its use, the transform is used to obtain the response of the ray to the following types of lens displacements: 1) any arbitrary sequence of displacements, 2) sinusoidal lens displacements of arbitrary frequency, 3) sinusoidal lens displacements at the ray position resonant frequency, and 4) lens displacements that form a bend in the guide. Also an analogy is shown to exist between the response of linear circuits to amplitude modulated pulse trains, which is a function of time, and the response of the light ray to lateral lens displacements, which is a function of the distance of propagation down the guide.

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On Guided Waves in Moving Anisotropic Media

J.A. Kong and D.K. Cheng. "On Guided Waves in Moving Anisotropic Media." 1968 Transactions on Microwave Theory and Techniques 19.2 (Feb. 1968 [T-MTT]): 99-103.

Based upon the Maxwell-Minkowski theory, the equations governing the propagation of electromagnetic waves in a cylindrical waveguide of an arbitrary cross section filled with a moving anisotropic medium are derived. The governing equations are reducible to a pair of coupled wave equations in the axial components of the electric and magnetic fields, which in turn can be solved through the solution of a single second order scalar homogeneous Hehnholtz equation. For a general anisotropic medium no pure TM or TE modes can exist in the waveguide. However, if the moving medium is uniaxially anisotropic, TM and TE modes are possible. It is interesting to note that the cutoff frequencies are always lowered by a factor which depends upon the velocity of the medium and is independent of the guide geometry. The formulas for the characteristic wave impedance and power flow in a waveguide for a moving uniaxial medium, if expressed in terms of the new cutoff frequency, have the same forms as those for a moving isotropic medium. The propagation characteristics of waveguides of rectangular and circular cross sections filled with a moving uniaxial gyroelectric medium are discussed.

Abstracts

Modes and Instabilities of Modes of the Flat-Roof Open Resonator

P.F. Checcacci, A. Consortini and A. Scheggi. "Modes and Instabilities of Modes of the Flat-Roof Open Resonator." 1968 Transactions on Microwave Theory and Techniques 19.2 (Feb. 1968 [T-MTT]): 103-109.

The problem of modes and losses of a resonator terminated by "flat-roof" reflectors is approached with the Fox and Li method of iteration. Field distributions, phaseshifts, and losses for some of the low-order modes are derived as functions of the roof angle and mirror aperture. A good agreement is found with the approximate theory previously developed by Toraldo di Francia. High loss regions are also observed. The behavior of different modes in such regions is investigated in detail. Design guidelines are given too. Experimental texts carried out on an X-band model confirm the theoretical predictions.

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A Class of Broadband Three-Port TEM-Mode Hybrids

S.B. Cohn. "A Class of Broadband Three-Port TEM-Mode Hybrids." 1968 Transactions on Microwave Theory and Techniques 19.2 (Feb. 1968 [T-MTT]): 110-116.

The three-port hybrid considered in this paper is useful both as a power divider and power combiner. In the divider application, power entering the input port is split equally and with zero phase difference between the output ports. All ports are well matched and the output ports are highly isolated. The generalized form of the hyhrid circuit is a T junction followed by a multiplicity of cascaded pairs of TEM line lengths and interconnecting resistors. Due to symmetry, the resistors are decoupled from the input port, but they serve an essential function in providing output-port match and isolation. Each pair of lines and its associated resistor are referred to as a section. The one-section hybrid has been known and widely used. Its usable bandwidth is f/sub 2/ / f/sub 1/ =1.44:1 for VSWR <1.22 and isolation >20 dB. This paper shows that additional sections can provide a large increase in bandwidth. Some of the examples treated are as follows: two sections, f/sub 2/ / f/sub 1/ =2, VSWR <1.11, isolation> 27 dB; four sections, f/sub 2/ / f/sub 1/ =4, VSWR <1.10, isolation >26 dB; and seven sections, f/sub 2/ / f /sub 1/ =10, VSWR <1.21, isolation >19 dB. Exact design formulas are given for two-section hybrids, and approximate design formulas for three or more sections.

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Wave Propagation in a Rectangular Waveguide Inhomogeneously Filled with Semiconductors (Correspondence)

R.H. Sheikh and M.W. Gunn. "Wave Propagation in a Rectangular Waveguide Inhomogeneously Filled with Semiconductors (Correspondence)." 1968 Transactions on Microwave Theory and Techniques 19.2 (Feb. 1968 [T-MTT]): 117-121.

A comparison of exact and approximate calculations of the propagation constant of a rectangular waveguide containing a centrally placed piece of semiconducting material has been made. The results show that the approximate solutions are subject to considerable error and also indicate a linear relationship between attenuation constant and conductivity that may be useful for the measurement of the semiconductor properties.

Abstracts

Waveguide Connector Measurements with a Millimeter-Wave Reflectometer (Correspondence)

O.L. Patty, W.E. Little and M.H. Zanboorie. "Waveguide Connector Measurements with a Millimeter-Wave Reflectometer (Correspondence)." 1968 Transactions on Microwave Theory and Techniques 19.2 (Feb. 1968 [T-MTT]): 121-123.

A system is described which extends reflection coefficient measurement techniques to E-band (60 to 90 GHz). Special apparatus and procedures are discussed. A new graphical presentation of reflectometer data is given which simplifies the measurement of connector impedance. Examples of the measured reflection coefficient magnitudes of some common E-band connectors are given.

Abstracts

Standing-Wave Ratio of Binary TEM Power Dividers (Correspondence)

H.J. Hindin. "Standing-Wave Ratio of Binary TEM Power Dividers (Correspondence)." 1968 Transactions on Microwave Theory and Techniques 19.2 (Feb. 1968 [T-MTT]): 123-125.

The theoretical input VSWR of "binary" TEM power dividers has been calculated. The purpose of this correspondence is to present this VSWR as a function of a normalized frequency variable both analytically for any power division and graphically for dividers up to 32-way. This material is both theoretically and practically interesting because of the extensive use of dividers of this type.

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3-dB Couplers Constructed from Two Tandem Connected 8.34-dB Asymmetric Couplers (Correspondence)

H.J. Hindin and A. Rosenzweig. "3-dB Couplers Constructed from Two Tandem Connected 8.34-dB Asymmetric Couplers (Correspondence)." 1968 Transactions on Microwave Theory and Techniques 19.2 (Feb. 1968 [T-MTT]): 125-126.

The technique of tandeming two symmetric 8.34-dB directional couplers to produce a 3-dB coupler has been described. This technique is useful because broadband 3-dB couplers are difficult to synthesize directly, due to the impedance levels involved. This correspondence shows that it is possible to tandem connect two asymmetric 8.34-dB couplers to yield a broadband 3-dB device. Design tables for 8.34-dB asymmetric couplers which give the normalized even-mode impedances required for a given ripple, number of sections, and bandwidth are also presented.

Abstracts

The Impedance Wall Concept Applied to a Dielectrically Loaded Waveguide Problem (Correspondence)

P. Bernardi and F. Valdoni. "The Impedance Wall Concept Applied to a Dielectrically Loaded Waveguide Problem (Correspondence)." 1968 Transactions on Microwave Theory and Techniques 19.2 (Feb. 1968 [T-MTT]): 126-127.

The impedance wall concept is applied to solve the problem of the propagation of TE zero-order modes in a rectangular waveguide, loaded by a thin and high dielectic constant slab against one sidewall. In this way, a good approximate solution is readily obtained.

Abstracts

Some Electromagnetic Wave Functions for Propagation Along Cylindrically Stratified Columns (Correspondence)

R. Burman. "Some Electromagnetic Wave Functions for Propagation Along Cylindrically Stratified Columns (Correspondence)." 1968 Transactions on Microwave Theory and Techniques 19.2 (Feb. 1968 [T-MTT]): 127-129.

This correspondence deals with azimuth-independent electromagnetic fields in cylindrically stratified media with permittivity which is either a scalar or a uniaxial tensor. Some exact wave functions are obtained.

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A Microwave Phase Bridge Technique for Measuring the Mutual Coupling of Identical Coupled Antennas (Correspondence)

R.J. Mailloux and F.J. LaRussa. "A Microwave Phase Bridge Technique for Measuring the Mutual Coupling of Identical Coupled Antennas (Correspondence)." 1968 Transactions on Microwave Theory and Techniques 19.2 (Feb. 1968 [T-MTT]): 129-130.

A waveguide phase bridge technique is developed for measuring the phase of the coupled signal between two loosely coupled antennas. This measurement, combined with the measurement of the coupled signal amplitude, provides a simple and direct method of measuring antenna mutual coupling parameters.

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Computation of RF Surface Resistance Using the Anomalous Skin Effect Theory (Correspondence)

L.W. Duncan. "Computation of RF Surface Resistance Using the Anomalous Skin Effect Theory (Correspondence)." 1968 Transactions on Microwave Theory and Techniques 19.2 (Feb. 1968 [T-MTT]): 130-131.

The anomalous skin effect is briefly reviewed. Using the results of this theory for the case of diffuse reflection, a procedure and pertinent information are provided for computing the RF surface resistance of several metals

Abstracts

Broadband Stripline Balun Using Quadrature Couplers (Correspondence)

S. Walker. "Broadband Stripline Balun Using Quadrature Couplers (Correspondence)." 1968 Transactions on Microwave Theory and Techniques 19.2 (Feb. 1968 [T-MTT]): 132-133.

Many new balun designs have been discussed in the literature in recent years. In most cases, a wide bandwidth has been a key design objective. The design to be discussed in this correspondence achieves this objective by exploiting the quadrature properties of stripline, parallel line directional couplers. Such quadrature couplers can be designed for extremely broad bands by the use of multiple sections. The design of the coupler used in the circuit described herein is covered fully by Shimizu and Jones and will not be repeated here. A schematic diagram of a balun using two 3-dB quadrature couplers is shown in Fig. 1. Its operation can be easily explained.

Abstracts

Diode Loop Binary Phase Shifter (Correspondence)

W.R. Connerney. "Diode Loop Binary Phase Shifter (Correspondence)." 1968 Transactions on Microwave Theory and Techniques 19.2 (Feb. 1968 [T-MTT]): 134-135.

The subject of this correspondence is a diode controlled, binary, phasing device. It consists basically of an all pass c-network, which is bypassed through a single diode, with a second diode used to improve the input match. The operating principle is discussed and then compared to other types of diode phase shifters, i.e., loaded line, hybrid, and switched line. Calculated performance curves are included.

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Applications of the Numerical Solution to Laplace's Equation in Three Dimensions (Correspondence)

D.H. Sinnott. "Applications of the Numerical Solution to Laplace's Equation in Three Dimensions (Correspondence)." 1968 Transactions on Microwave Theory and Techniques 19.2 (Feb. 1968 [T-MTT]): 135-136.

The development of techniques for the solution of Laplace's equation in three dimensions is discussed. Comparison is made of computed results with accurately known fignres for the case of an open-circuited coaxial line. An application to the design of a coaxial to slab line transition is presented.

Abstracts

A Nonreciprocal Circular Polarizer (Comments)

M.L. Reuss, Jr.. "A Nonreciprocal Circular Polarizer (Comments)." 1968 Transactions on Microwave Theory and Techniques 19.2 (Feb. 1968 [T-MTT]): 136-136.

In a recent paper, the author described two models of a nonreciprocal circular polarizer. The second model was a two-stage device in which the second stage provided a refinement of the approximate circular polarization produced by the first stage. The device used for this purpose consisted of a circular waveguide with a ferrite rod along its axis, so dimensioned that one sense of circular polarization could propagate but not the other. It has been called to the author's attention that a theoretical basis for such a device was provided in a series of papers by Waldron. Furthermore, a patent embodying the application of this principle was obtained by him.

Abstracts

Contributors (Feb. 1968 [T-MTT])

K.S. Champlin, P.F. Checcacci, D.K. Cheng, S.B. Cohn, A. Consortini, J.C. Daly, G.H. Glover, J.D. Holm, J.-A. Kong, R. Levy, L.F. Lind, N.A. Patrin, J.D. Rhodes, S.O. Scanlan and A. Scheggi. "Contributors (Feb. 1968 [T-MTT])." 1968 Transactions on Microwave Theory and Techniques 19.2 (Feb. 1968 [T-MTT]): 136-138.

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Precise Design of Coaxial Low-Pass Filters

R. Levy and T.E. Rozzi. "Precise Design of Coaxial Low-Pass Filters." 1968 Transactions on Microwave Theory and Techniques 16.3 (Mar. 1968 [T-MTT]): 142-147.

The coaxial low-pass filters described are of the conventional stepped impedance type consisting of a cascade of alternating low and high impedance sections of line. Exact prototype filters having Chebyshev equal-ripple characteristics are obtained from published tables giving the characteristic impedances of the sections. The capacitive discontinuities at the junctions are compensated by a new method which is exact at the cutoff frequency, and nearly exact in the region of this frequency. The production of low-pass filters with a passband VSWR of 1.05 or less is feasible and experimental results are described for such designs.

Abstracts

Printed-Circuit Complementary Filters for Narrow Bandwidth Multiplexers

R.J. Wenzel. "Printed-Circuit Complementary Filters for Narrow Bandwidth Multiplexers." 1968 Transactions on Microwave Theory and Techniques 16.3 (Mar. 1968 [T-MTT]): 147-157.

Design techniques and interconnection equivalent circuits are presented for constricting low-cost printed-circuit narrowband complementary filters. The techniques and circuits described allow the achievement of contiguous band multiplexers using a single printed circuit board with no series or shorted stubs. Equivalent circuit transformations useful in obtaining practical designs and experimental results for a two-section stripline complementary filter pair are also given. While emphasis is placed on printed-circuit filters, the interconnection circuits and design techniques presented can be applied in the design of narrowband multiplexers using many other filter types.

Abstracts

Broadband Matching of Resonant Circuits and Circulators

E. Schwartz. "Broadband Matching of Resonant Circuits and Circulators." 1968 Transactions on Microwave Theory and Techniques 16.3 (Mar. 1968 [T-MTT]): 158-165.

In the first part of this paper a broadband matching theory of resonant circuits is developed. It is not assumed that the center frequency of the matching interval is equal to the resonance frequency of the resonant circuit. The upper limits of optimum broadband matching are derived with the aid of Fano's integrals. Furthermore it is shown how we can approach these ripper limits as well as desired with real matching two-ports with Chebyshev response. This broadband matching theory of resonant circuits may be applied to circulators if the input impedances of the circulators can he represented approximately by resonant circuits. This problem is treated in the second part of the paper.

Abstracts

Application of the Solutions of Certain Boundary Value Problems to the Symmetrical Four-Port Junction and Specially Truncated Bends in Parallel-Plate Waveguides and Balanced Strip-Transmission Lines

J.J. Campbell. "Application of the Solutions of Certain Boundary Value Problems to the Symmetrical Four-Port Junction and Specially Truncated Bends in Parallel-Plate Waveguides and Balanced Strip-Transmission Lines." 1968 Transactions on Microwave Theory and Techniques 16.3 (Mar. 1968 [T-MTT]): 165-176.

Three boundary value problems involving parallel-plate waveguides terminated in various combinations of electric and magnetic walls are investigated. The analysis leads to infinite sets of linear algebraic equations, which are appropriately truncated and solved on an electronic computer. The results are applied to several problems: to the scattering matrix of the symmetrical four-port junction of parallel-plate or rectangular waveguides; to the symmetrical four-port junction of center strips of a balanced strip-transmission line; to a specially truncated right-angle bend in parallel-plate and rectangular waveguides; and to mitred bends in strip-transmission lines.

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A New Type of Latching Switchable Ferrite Junction Circulator (Mar. 1968 [T-MTT])

W.W. Siekanowicz and W.A. Schilling. "A New Type of Latching Switchable Ferrite Junction Circulator (Mar. 1968 [T-MTT])." 1968 Transactions on Microwave Theory and Techniques 16.3 (Mar. 1968 [T-MTT]): 177-183.

This paper presents an approximate theory and initial performance data for a new type of latching, switchable, ferrite junction circulator that is well suited for applications requiring fast (fractions of or several microseconds), low-energy (tens of microjoules in the microwave region) switching. The novelty of the device is the use of oppositely magnetized ferrite cylinder-and-ring assemblies within the region of circulation. The approximate theory yields the radius for circulation, bandwidth, and input impedance as functions of material properties and frequency. Operation of latched circulators has been demonstrated on assemblies operating in the region of 7.3 and 5.4 GHz. Insertion losses from 0.25 to 0.4 dB, 20-dB isolation bandwidths from 2.4 to 8.3 percent, and switching energies from 15 to 30 µJ have been obtained.

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Circumferential Gap in a TE/sub 01/-Mode-Transmitting Multimode Circular Waveguide

N. Morita and Y. Nakanishi. "Circumferential Gap in a TE/sub 01/-Mode-Transmitting Multimode Circular Waveguide." 1968 Transactions on Microwave Theory and Techniques 16.3 (Mar. 1968 [T-MTT]): 183-189.

Higher-order modes produced in a guide and fields radiated out of a guide by a circumferential gap in a multimode circular waveguide that is used for millimeter wave transmission, were investigated by means of fictitious equivalent magnetic current for the gap. These results were compared with the analysis obtained by Bethe's method, which was used for the problem of diffraction of fields by a small hole in a plane conducting sheet. The two results agreed well for narrow gap.

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The Insertion Loss of Transmission Lines Used in Matching Networks (Correspondence)

L.J. Ricardi. "The Insertion Loss of Transmission Lines Used in Matching Networks (Correspondence)." 1968 Transactions on Microwave Theory and Techniques 16.3 (Mar. 1968 [T-MTT]): 189-191.

The insertion loss of a section of transmission line is usually not a linear function of its length whenever the line is not terminated in its characteristic impedance. This is because the conductor losses exceed the dielectric losses and are usually evident in the form of "hot spots" coincident with the current maxima. This correspondence presents the rigorous expressions and corresponding curves which enable the calculation of the loss of a transmission line terminated in a mismatch and the losses in a matching network employing transmission lines.

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Some General Properties of Commensurate-Linelength Complementary and Pseudo-Complementary Microwave Filters (Correspondence)

R.J. Wenzel. "Some General Properties of Commensurate-Linelength Complementary and Pseudo-Complementary Microwave Filters (Correspondence)." 1968 Transactions on Microwave Theory and Techniques 16.3 (Mar. 1968 [T-MTT]): 191-192.

A perfect match at the common port of a diplexer requires the component filters to be complementary. Pseudo-complementary filters provide increased selectivity in comparison with complementary filters for a given number of sections by allowing a relatively small (and closely controlled) input-port mismatch. Design techniques for specific contiguous band multiplexer incorporating complementary or pseudo-complementary filters have been described in detail in recent publications. These design techniques, however, have been restrictive in the physical form that could be utilized in realizing the component filters, and somewhat vague in predicting the performance that would be achieved in the general case. The purpose of this correspondence is to present some general design techniques and specific theoretical results applicable to complementary and pseudo-complementary microwave filters. The results to be presented apply to filters of arbitrary bandwidth that utilize any desired combination of LC ladder elements (designated m type) and unit elements (designated n type). The techniques described are applicable to interdigital, parallel-coupled, general stub type, and many other related filter forms and are simply expendable to elliptic function type filters. Although no optimum criteria for pseudo-complementary filters have been formulated, a nearly equal-ripple input VSWR characteristic has been obtained from analysis of many filters designed using the techniques to be described. Because of these results, it is felt that the procedures described do result in near optimum performance.

Abstracts

A New Type of Waveguide-to-Stripline Transition (Correspondence)

R.H. Knerr. "A New Type of Waveguide-to-Stripline Transition (Correspondence)." 1968 Transactions on Microwave Theory and Techniques 16.3 (Mar. 1968 [T-MTT]): 192-194.

There is a growing interest in integrated microwave stripline circuits using thin film and printed circuit techniques. Recent developments responsible for this integrated circuit interest include transistor amplifiers at microwave frequencies and several other components, such as circulators or couplers, all using stripline. These components are much smaller than the corresponding waveguide components and show at least equal electrical performance. The use of these printed integrated circuits in connection with waveguide systems creates the need for a direct, high performance broadband transition from waveguide to stripline. This device replaces the more costly transitions from waveguide to coax and then from coax to stripline. The transition is also an integral part of the strip-line circuitry, permitting smaller and less expensive integrated devices since both the waveguide and the stripline parts may be included in the same housing.

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Semiconductor Rod in Waveguide--Field Distribution for Positive and Negative Conductivity (Correspondence)

J.B. Anderson and B. Majborn. "Semiconductor Rod in Waveguide--Field Distribution for Positive and Negative Conductivity (Correspondence)." 1968 Transactions on Microwave Theory and Techniques 16.3 (Mar. 1968 [T-MTT]): 194-196.

The electromagnetic field distribution inside as well as outside a circular cylindrical rod of arbitrary complex permittivity placed in a rectangular waveguide has been computed. Amplification and resonance phenomena are found in the case of a rod with a negative conductivity.

Abstracts

A Microwave Integrated Circuit Avalanche-Diode Oscillator (Correspondence)

R. Blau. "A Microwave Integrated Circuit Avalanche-Diode Oscillator (Correspondence)." 1968 Transactions on Microwave Theory and Techniques 16.3 (Mar. 1968 [T-MTT]): 196-197.

Peak power of 1.4 watts has been obtained from a passivated silicon chip operated as a pulsed avalanche oscillator in a microwave integrated circuit. To our knowledge, although microwave oscillations from avalanche diodes under various conditions have been reported, these are the first such results reported in microwave integrated circuits.

Abstracts

Mode Conversion in Short Conical and Asymmetrical-Rectangular Waveguide Tapers (Correspondence)

K. Tomiyasu. "Mode Conversion in Short Conical and Asymmetrical-Rectangular Waveguide Tapers (Correspondence)." 1968 Transactions on Microwave Theory and Techniques 16.3 (Mar. 1968 [T-MTT]): 197-199.

Many tapers have been designed and built in circular waveguides transmitting the T°/sub 01/ mode. Generally, the requirement has been very low mode conversion over a wide bandwidth. Tapers which meet this requirement have a continuously variable taper angle, and the taper lengths are quite long. Where relatively short tapers and narrow bandwidths are required, a multiconical approach has been proposed. Theoretical design information is available; however, no experimental data are available. This correspondence describes some results on short circular and asymmetrical-rectangular waveguide experimental tapers, with dimensions chosen so as to deliberately generate mode conversion of sufficient amplitude to facilitate its measurement.

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Input VSWR and Output Isolation of Lossy N-Way Hybrid Power Dividers (Correspondence)

H.J. Hindin. "Input VSWR and Output Isolation of Lossy N-Way Hybrid Power Dividers (Correspondence)." 1968 Transactions on Microwave Theory and Techniques 16.3 (Mar. 1968 [T-MTT]): 199-201.

This correspondence presents analytic and graphical information on the input VSWR and output isolation of lossy N-way hybrid power dividers as a function of frequency and loss. The particular device considered was described by Wilkinson and then by Peterson. The input VSWR and output isolation were derived and presented in graphical form by Taub and Fitzgerald for lossless devices using an extension of the even- and odd-modes technique of Reed and Wheeler. This technique, in which the transmission lines are considered to be lossy, is now used. The effect of loss has become of importance recently due to the increased use of miniature and/or integrated circuit techniques. This loss puts bounds on the best VSWR and isolation that can be achieved. These bounds are of both theoretical and practical interest.

Abstracts

Experimental Confirmation of Barretter Substitution Error (Correspondence)

J.W. Adams and R.F. Desch. "Experimental Confirmation of Barretter Substitution Error (Correspondence)." 1968 Transactions on Microwave Theory and Techniques 16.3 (Mar. 1968 [T-MTT]): 201-202.

Agreement of measured values of substitution error in barretters with calculated values based on a theoretical analysis by Carlin and Sucher substantiates both the measured and calculated values. The confirmed theory has interesting possible applications, such as confirmation of accuracy of existing measurement techniques and exstension to millimeter-wave power measurement.

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Effect of "Ring Resonance" in Circulator Time-Delay Circuit (Correspondence)

C.A. Shipley. "Effect of "Ring Resonance" in Circulator Time-Delay Circuit (Correspondence)." 1968 Transactions on Microwave Theory and Techniques 16.3 (Mar. 1968 [T-MTT]): 202-203.

A switchable time-delay circuit using two reversible 3-port circulators connected to unequal lengths of transmission line is shown in Fig. 1. The circulator switches will direct an incoming signal through one of the two alternate paths through the network. The differential time delay is proportional to the difference in length between the two paths.

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Contributors (Mar. 1968 [T-MTT])

J.J. Campbell, R. Levy, N. Morita, Y. Nakanishi, T.E. Rozzi, W.A. Schilling, E. Schwartz, W.W. Siekanowicz and R.J. Wenzel. "Contributors (Mar. 1968 [T-MTT])." 1968 Transactions on Microwave Theory and Techniques 16.3 (Mar. 1968 [T-MTT]): 204-205.

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Information for Authors (Mar. 1968 [T-MTT])

"Information for Authors (Mar. 1968 [T-MTT])." 1968 Transactions on Microwave Theory and Techniques 16.3 (Mar. 1968 [T-MTT]): 206-206.

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Membership Application (Mar. 1968 [T-MTT])

"Membership Application (Mar. 1968 [T-MTT])." 1968 Transactions on Microwave Theory and Techniques 16.3 (Mar. 1968 [T-MTT]): 207-207.

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A Miniature High-Q Bandpass Filter Employing Dielectric Resonators

W.H. Harrison. "A Miniature High-Q Bandpass Filter Employing Dielectric Resonators." 1968 Transactions on Microwave Theory and Techniques 16.4 (Apr. 1968 [T-MTT]): 210-218.

The miniaturization of high-Q resonant microwave structures is of great importance. This must he done to keep pace with the size reduction of other related components. The need has led to an investigation into the feasibility of using dielectric materials as microwave resonators. This paper deals with the application of the TiO/sub 2/ dielectric resonator in a narrowband bandpass filter operating in the 2200 to 2300 MHz telemetry band. The study confirms the theory that a bandpass filter employing dielectric resonators is practical to build, is compact, and will approach the performance of an equivalent waveguide filter. The design employed five resonators mounted in a cylindrical tube that was 1.4 inches in diameter by 4.3 inches long and weighed 4.6 ounces. An equivalent waveguide filter would be approximately 2.3x4.5x16 inches long and would weigh approximately 64 ounces (WR-430). The thermal sensitivity of the dielectric resonator employing TiO/sub 2/ is an inherent problem and oven regulation for narrowband applications will be required. Small, inexpensive thermal jackets are available that will control the filter stability to a value equal to, or better than, that obtained with a filter utilizing aluminum cavities operating in a typical uncontrolled temperature environment.

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Microwave Bandpass Filters Containing High-Q Dielectric Resonators

S.B. Cohn. "Microwave Bandpass Filters Containing High-Q Dielectric Resonators." 1968 Transactions on Microwave Theory and Techniques 16.4 (Apr. 1968 [T-MTT]): 218-227.

This paper is concerned with dielectric disks used as resonators in microwave bandpass filters. For many years it has been known that modes of resonance occur in isolated dielectric bodies having air boundaries, and that very compact high-Q resonators can be achieved when /spl epsiv/ /sub r/, is high and tan /spl delta/ is low. High-purity TiO/sub 2/ ceramic material, for example, has an /spl epsiv/ /sub r/ about 100, tan /spl delta/ about 0.0001, and Q/sub u/ about 10 000. Practical applications of dielectric resonators have previously been limited by insufficient design information. Formulas are derived for the coupling coefficient between adjacent dielectric-disk resonators within a metal waveguide below cutoff. This metal enclosure is necessary for shielding and to prevent radiation loss. Comparisons between theoretical and experimental coupling coefficient values show very good agreement in each of the three bandpass configurations treated in this paper. Techniques of loop and probe coupling to the end resonators of a multiresonator bandpass filter are discussed and methods of supporting the resonators are suggested. The conclusion is made that microwave dielectric resonators offer important size reductions compared to conventional resonators of similar high Q, but that the center-frequency change of the dielectric resonators as a function of temperature is excessive for many applications. Temperature stabilization is one solution, but preferably a material should be developed having electrical characteristics similar to TiO/sub 2/ ceramic, but with at least an order of magnitude improvement in temperature sensitivity.

Abstracts

Approximation Technique for Dielectric Loaded Waveguides

W.E. Hord and F.J. Rosenbaum. "Approximation Technique for Dielectric Loaded Waveguides." 1968 Transactions on Microwave Theory and Techniques 16.4 (Apr. 1968 [T-MTT]): 228-233.

An algebraic procedure is described which yields approximate values for the cutoff frequencies and propagation constants of dielectric-loaded waveguides. The procedure is demonstrated for a waveguide completely filled with an anisotropic dielectric and for waveguides partially filled with isotropic dielectrics. For the latter case results are tabulated for five types of waveguide loading. The symmetrically loaded waveguide is used to show the accuracy which may be expected. This procedure is shown to be identical with the Rayleigh-Ritz variational method but with the advantage that it provides a systematic approach to improve the accuracy and to handle a multitude of waveguide geometries.

Abstracts

Noise in Synchronized Oscillators

K. Kurokawa. "Noise in Synchronized Oscillators." 1968 Transactions on Microwave Theory and Techniques 16.4 (Apr. 1968 [T-MTT]): 234-240.

Noise in synchronized oscillators is analyzed using a simple oscillator model. It is shown that the FM noise can be considerably improved by synchronization while the AM noise degrades slightly. It is also shown how the noise spectrum becomes unsymmetrical with respect to the synchronizing freqnency when it differs from the free-running frequency.

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The Paradoxical Surface Wave (Crack Wave) in Ferrite-Filled Waveguides

R.R.J. Gagne. "The Paradoxical Surface Wave (Crack Wave) in Ferrite-Filled Waveguides." 1968 Transactions on Microwave Theory and Techniques 16.4 (Apr. 1968 [T-MTT]): 241-250.

Existing theories that relate to propagation in a rectangular waveguide loaded with a transversely magnetized slab of ferrite are reviewed and new points brought out. In the loss-free case, in which the ferrite stab lies against one of the waveguide walls, conflicting results are obtained. If the width of the air gap between the ferrite slab and the waveguide wall is set equal to zero, a single surface wave propagating in one direction only is predicted. This result leads to a thermodynamic paradox. If, however, the air gap is assumed infinitely small but different from zero, two surface wave modes, which transport energy in opposite directions, are predicted. The aim of this paper is to establish whether or not a surface wave exists when there is no air gap for a real structure which is not free of loss. The experimental results show conclusively that the surface wave is present. It is concluded that a mathematical model is required, which assumes losses. If for reasons of simplicity a lossless model is used, then it must be assumed that the width of the air gap is never identical to zero. The structure selected for the experimental work consisted of a rectangular block of ferrite that completely filled the cross section of an X-band waveguide.

Abstracts

Variational Method for the Analysis of Microstrip Lines

E. Yamashita and R. Mittra. "Variational Method for the Analysis of Microstrip Lines." 1968 Transactions on Microwave Theory and Techniques 16.4 (Apr. 1968 [T-MTT]): 251-256.

This paper reports a method for computing the line capacitance of a microstrip line based on the application of Fourier transform and variational techniques. The characteristic impedance, guide wavelength, and the surface potential distribution in the microstrip line are obtained for a range of structure parameters and the dielectric constant. The results calculated from the expressions developed in the paper are compared with the theoretical results presently available in the literature and good agreement is found. Comparison with available experimental results is also made where feasible. Possible applications and limitations of the method are discussed.

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The Theoretical Design of Broadband 3-Port Waveguide Circulators (Correspondence)

C.G. Parsonson, S.R. Longley and J.B. Davies. "The Theoretical Design of Broadband 3-Port Waveguide Circulators (Correspondence)." 1968 Transactions on Microwave Theory and Techniques 16.4 (Apr. 1968 [T-MTT]): 256-258.

An extension of earlier field analysis has made possible the prediction, purely by theory, of broadband 3-port H-plane circulator designs. Using a configuration consisting of concentric rings of ferrite and dielectric material surrounding a conducting post in the center of the junction, circulators with isolation bandwidths up to 42 percent have been predicted. In practice, bandwidths up to 30 percent have been obtained in X band and bandwidths of about 20 percent in C and Q band.

Abstracts

On Using the Q of Transmission Lines (Correspondence)

W.T. Jones and J.R. Griffin. "On Using the Q of Transmission Lines (Correspondence)." 1968 Transactions on Microwave Theory and Techniques 16.4 (Apr. 1968 [T-MTT]): 258-260.

The realization of bandpass filters and impedance matching networks consisting of cascaded series and shunt segments of a transmission line is facilitated by a design procedure which relates the Q of individual frequency selective sections to the total required Q (denoted by Q/sub T/) and the desired network response. The method described herein gives exact results for two- and three-section networks and yields a close approximation to the desired response for higher order networks if Q/sub T/ is not too small. A general form of the transmission-line network to be considered is shown in Fig. 1, where series elements are impedance transformers and shunt elements are shorted stubs. All characteristic impedances are assumed to be real and Theta refers to electrical length.

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Note on Perturbation Analysis of Guided Waves in Inhomogeneous Media (Correspondence)

I.C. Chang. "Note on Perturbation Analysis of Guided Waves in Inhomogeneous Media (Correspondence)." 1968 Transactions on Microwave Theory and Techniques 16.4 (Apr. 1968 [T-MTT]): 260-261.

Perturbation methods have been widely used in the past for solving electromagnetic problems, particularly on resonant cavities. Recently it has been extended to the solution of guided waves in anisotropic and inhomogeneous media. The standard perturbation procedure usually starts with an expansion in powers of a small "perturbation parameter" tau and arrives at a set of recursive differential equations in "various order of perturbation." In doing so, one implicitly assumes that the perturbed solution so obtained will converge uniformly to the unperturbed solution as the perturbation parameter tau tends to zero. This, however, is not the case for waveguides filled with inhomogeneous media. Near the perturbing media the difference between the perturbated and the unperturbed fields remains finite as the perturbing volume becomes smaller and smaller. As a result the standard perturbation procedure yields rather poor approximations as the permittivity epsilon and permeability μ increase. This singular character of perturbation has been observed before, for instance, in the well-known Bethe-Sehwinger perturbation formula. It is the purpose of this correspondence to develop a modified perturbation method for guided structures containing anisotropic and inhomogeneous media.

Abstracts

Mode Propagation in Multilayered Dielectric Loaded Waveguides by Ray Theory (Correspondence)

J.E. Robinson and M.A. Hamid. "Mode Propagation in Multilayered Dielectric Loaded Waveguides by Ray Theory (Correspondence)." 1968 Transactions on Microwave Theory and Techniques 16.4 (Apr. 1968 [T-MTT]): 261-261.

The concept of angular spectrum of plane waves is used to extend Officer's solution for the electric field in a rectangular waveguide loaded by a single dielectric layer to deal with the more general case of multiple layers. It is shown that only few scattered rays are needed in order to obtain a simple approximate solution for the case of oblique ray incidence and small number of dielectric layers.

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An Improved Method for Measuring Scattering Parameters of Nonreciprocal Two-Ports (Comments and Authors' Reply)

H.M. Altschuler, G.R. Hoffman and A.A. Willem. "An Improved Method for Measuring Scattering Parameters of Nonreciprocal Two-Ports (Comments and Authors' Reply)." 1968 Transactions on Microwave Theory and Techniques 16.4 (Apr. 1968 [T-MTT]): 261-262.

In the above correspondence Hoffman and Willem suggest as new that, to reduce measurement uncertainty, the ratio |a/sub 1//a/sub2/| can be judiciously adjusted to obtain magnification or shrinking of the data loci. This author would agree with their conclusion but would like to point out that this technique was fully discussed several years ago. Their contribution then lies in the innovation of using a family of circles based on several |a/sub 1//a/sub 2/| ratios to obtain still further averaging of both phase and magnitude. While the use of several |a/sub 1//a/sub 2/| ratios certainly has its superficial attractions, caution is needed against its use in the context of their procedure and of the experimental setup of their Fig. 3: The "bridge imbalance" error, i.e., either the uncertainty in first adjusting |a/sub 1/| to equal |a/sub 2/| or that of determining the value of |a/sub 1//a/sub 2/|, contributed by the use of only a single slotted line, can easily overshadow the errors that are presumably reduced by the authors' approach. Consequently, it is suggested that two slotted lines and careful bridge balancing techniques be used in any case, especially when the average data of several concentric circles is taken in the hope of reducing measurement uncertainty.

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Note on Reflectometer for Measuring the Magneto-Microwave Kerr Effect in Semiconductors (Correspondence)

R.J. Vernon. "Note on Reflectometer for Measuring the Magneto-Microwave Kerr Effect in Semiconductors (Correspondence)." 1968 Transactions on Microwave Theory and Techniques 16.4 (Apr. 1968 [T-MTT]): 262-262.

Hauge and Champlin recently described an interesting new system which they used to measure the magneto-microwave Kerr effect semiconductors. In response to their discussion of this system certain features should be pointed out concerning another reflectometer used earlier for a similar purpose by Brodwin and Vernon.

Abstracts

A New Microwave Low-Pass Structure (Correspondence)

R.V. Snyder. "A New Microwave Low-Pass Structure (Correspondence)." 1968 Transactions on Microwave Theory and Techniques 16.4 (Apr. 1968 [T-MTT]): 262-264.

It is the purpose of this correspondence to discuss a new "inside-out" realization for a microwave coaxial low-pass structure. This new structure will be shown to possess some inherent constructional advantages over the classical realization.

Abstracts

The Minimum Volume of an Equal-Element Bandpass Filter (Correspondence)

J.J. Taub. "The Minimum Volume of an Equal-Element Bandpass Filter (Correspondence)." 1968 Transactions on Microwave Theory and Techniques 16.4 (Apr. 1968 [T-MTT]): 264-265.

The purpose of this correspondence is to determine the number of resonators required to realize the minimum volume in an equal-element bandpass filter subject to the conditions of fixed midband insertion loss and rejection bandwidth. Since an equal-element filter has lower midband insertion loss than a Butterworth or Chebychev filter the criterion described herein should prove useful in miniature and integrated circuit applications requiring microwave bandpass filters.

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On the Scalar Product of Certain Circular and Cartesian Wave Functions (Correspondence)

N. Amitay and V. Galindo. "On the Scalar Product of Certain Circular and Cartesian Wave Functions (Correspondence)." 1968 Transactions on Microwave Theory and Techniques 16.4 (Apr. 1968 [T-MTT]): 265-266.

In many waveguide discontinuity and phased array problems, structures which are best described in circular coordinates abruptly change into structures which are best described in Cartesian coordinates (see Fig. 1).

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Contributors (Apr. 1968 [T-MTT])

S.B. Cohn, R.R.J. Gagne, W.H. Harrison, W.E. Hord, K. Kurokawa, R. Mittra, F.J. Rosenbaum and E. Yamashita. "Contributors (Apr. 1968 [T-MTT])." 1968 Transactions on Microwave Theory and Techniques 16.4 (Apr. 1968 [T-MTT]): 267-268.

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G-MTT Symposium (Apr. 1968 [T-MTT])

"G-MTT Symposium (Apr. 1968 [T-MTT])." 1968 Transactions on Microwave Theory and Techniques 16.4 (Apr. 1968 [T-MTT]): 269-271.

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"Table of Contents (May 1968 [T-MTT])." 1968 Transactions on Microwave Theory and Techniques 16.5 (May 1968 [T-MTT]): 273-273.

Abstracts

Mode Filters for Oversized Rectangular Waveguides

H.-J. Butterweck. "Mode Filters for Oversized Rectangular Waveguides." 1968 Transactions on Microwave Theory and Techniques 16.5 (May 1968 [T-MTT]): 274-281.

In order to suppress trapped-mode resonances and other disturbing phenomena related to the existence of higher-order modes in oversized waveguides, suitable mode filters are required. In this paper such filters are described for rectangular waveguides in which only the dominant H/sub 10/ mode is wanted. The unwanted modes to be suppressed by the mode filters are classified as 1) E/sub mn/ and H/sub mn/ modes with n /spl ne/ 0, and 2) H/sub m0/ modes with m /spl ne/ 1. These two types of modes must be treated separately and require different approaches to the mode-filtering problem. For both classes several constructions of mode filters are described and analyzed.

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Two-Mode Waveguide for Equal Mode Velocities

R.S. Elliott. "Two-Mode Waveguide for Equal Mode Velocities." 1968 Transactions on Microwave Theory and Techniques 16.5 (May 1968 [T-MTT]): 282-286.

A rectangular waveguide, with a T-septum attached to one of its side walls, is capable of supporting two modes with equal-phase velocities. Stationary expressions are developed for the cutoff wavelengths of these two modes as functions of the cross-sectional dimensions. A Rayleigh-Ritz procedure is used to produce families of curves relating each cutoff wavelength to the septum dimensions; intersections of corresponding curves establish theoretically those combinations of dimensions that permit the two modes to propagate at a common velocity. Experimental corroboration of the theory is also presented.

Abstracts

A Millimeter-Wave Quadrupler and an Up-Converter Using Planar-Diffused Gallium Arsenide Varactor Diodes

T.P. Lee and C.A. Burrus. "A Millimeter-Wave Quadrupler and an Up-Converter Using Planar-Diffused Gallium Arsenide Varactor Diodes." 1968 Transactions on Microwave Theory and Techniques 16.5 (May 1968 [T-MTT]): 287-296.

A millimeter-wave quadruple, employing planar-diffused GaAs varactor diodes and a tuned second-harmonic idler circuit, is described. This quadruple operated at an output frequency of 50.4 GHz, produced a maximum power output greater than 13 mW, and exhibited a maximum overall conversion efficiency of 12 percent. 2) A millimeter-wave up-converter using similar diffused GaAs diodes has been operated successfully. The input was at 1.3 GHz, the output at 51.7 GHz, and the local oscillator power was supplied at 50.4 GHz. The minimum observed overall conversion loss, 50.4 to 51.7 GHz, was about 2.5 dB at an output power between 1 and 3 mW. 3) The performance of these devices is described as a function of the parameters of the diodes employed, and a comparison of the performance of diffused-junction and Schottky-barrier diodes (of comparable quality) in the two circuits is discussed. 4) The fabrication and characterization of the planar-diffused gallium arsenide varactor diodes used in these circuits is described; zero-bias cutoff frequencies to values in excess of 2000 GHz were achieved.

Abstracts

Electromagnetic Wave Propagation in Twisted Anisotropic Media

J.B. DaSilva. "Electromagnetic Wave Propagation in Twisted Anisotropic Media." 1968 Transactions on Microwave Theory and Techniques 16.5 (May 1968 [T-MTT]): 296-302.

The complete solution of the differential equation describing the propagation of plane uniform TEM waves along the twist axis of a twisted anisotropic medium with a constant rate of twist is shown to be of exponential type, consisting of two identical pairs of independent propagation modes, each pair being associated with a particular direction of energy flow. Knowledge of the complete solution is used to solve the boundary value problem relative to wave penetration into a twisted medium at normal incidence, a numerical example being given illustrating the polarization transformation properties of the medium near the short wavelength limit. Analysis of mode properties reveals circnlar birefringence should occur in twisted media at long wavelengths. A link power, as shown by certain crystalline substances provided by the theory.

Abstracts

The Characteristic Impedance and Coupling Coefficient of Coupled Rectangular Strips in a Waveguide

M.K. Krage and G.I. Haddad. "The Characteristic Impedance and Coupling Coefficient of Coupled Rectangular Strips in a Waveguide." 1968 Transactions on Microwave Theory and Techniques 16.5 (May 1968 [T-MTT]): 302-307.

The effect of both the ground planes and sidewalls on the characteristic impedance and coupling coefficient of two coupled strip-lines are investigated. Numerical results are given that should aid in the design of miniature directional couplers where the sidewalls are close enough to the strips to have a large effect. It is shown, for example, that the coupling coefficient can be varied as a function of distance to enhance the bandwidth, while the impedance can he maintained constant to improve the directivity.

Abstracts

Noise in Double-Injection Space-Charge-Limited Solid-State Diodes (Correspondence)

A. Van der Ziel. "Noise in Double-Injection Space-Charge-Limited Solid-State Diodes (Correspondence)." 1968 Transactions on Microwave Theory and Techniques 16.5 (May 1968 [T-MTT]): 308-308.

A possible explanation is given of the fact that the noise in double-injection space-charge-limited solid-state diodes is smaller than for single-injection diodes. The effect is attributed to ambipolar diffusion noise.

Abstracts

Equivalent Circuit for a Lumped-Element Y Circulator (Correspondence)

J.O. Bergman and C. Christensen. "Equivalent Circuit for a Lumped-Element Y Circulator (Correspondence)." 1968 Transactions on Microwave Theory and Techniques 16.5 (May 1968 [T-MTT]): 308-310.

A new symbol for the ideal circulator with the impedance matrix (1) has been proposed (Fig. 2). The symbol is used in the derivation of the equivalent circuits for a lumped-element three-port circulator where the loss resistances are excluded.

Abstracts

High-Pass Transmission-Line Directional Coupler (Correspondence)

F. Arndt. "High-Pass Transmission-Line Directional Coupler (Correspondence)." 1968 Transactions on Microwave Theory and Techniques 16.5 (May 1968 [T-MTT]): 310-311.

A transmission-line directional coupler with a high-pass coupling characteristic is described. The coupler has a nearly equalripple coupling response in the passband and a small low-end cutoff frequency for a fixed length of the coupling section. Curves and data of the coupling factor are given and experimental results shown.

Abstracts

Data for Partially Decoupled Round Rods Between Parallel Ground Planes (Correspondence)

E.G. Cristal. "Data for Partially Decoupled Round Rods Between Parallel Ground Planes (Correspondence)." 1968 Transactions on Microwave Theory and Techniques 16.5 (May 1968 [T-MTT]): 311-314.

This correspondence presents new design data (Figs. 2 through 9) supplementary to those previously published for coupled round rods between parallel ground planes, which are anticipated to be useful in the design of UHF and TEM microwave components. The configuration of interest, shown in Fig. 1, shows that for the data herein the transmission lines are partially decoupled from each other by means of infinitesimally thin partitions between lines. The effect of the partitions forces the spacing between lines to be reduced for a given coupling and transmission-line radius, thereby providing a more compact structure.

Abstracts

Errors Due to the Uncertainty Principle in Swept-Frequency Cavity Measurements of Properties of Materials (Correspondence)

R.A. Waldron. "Errors Due to the Uncertainty Principle in Swept-Frequency Cavity Measurements of Properties of Materials (Correspondence)." 1968 Transactions on Microwave Theory and Techniques 16.5 (May 1968 [T-MTT]): 314-315.

It is shown that the uncertainty principle leads to errors in measurements of properties of materials, and that the errors can be serious under certain conditions.

Abstracts

Ferromagnetic Resonance in Unsaturated Planar Ferrites (Correspondence)

A. Christopher and L.M. Silber. "Ferromagnetic Resonance in Unsaturated Planar Ferrites (Correspondence)." 1968 Transactions on Microwave Theory and Techniques 16.5 (May 1968 [T-MTT]): 315-316.

The ferromagnetic resonance frequency has been calculated for a single crystal of a hexagonal ferrite having planar anisotropy, in the unsaturated state, as a function of static field applied in the hard direction (along the hexagonal C-axis). Experiments performed on samples of ZnMnY verify the essential features of the predicted behavior.

Abstracts

Insertion Loss Versus Normalized Frequency Curves for Mumford's Maximally Flat Filter (Correspondence)

H.J. Hindin. "Insertion Loss Versus Normalized Frequency Curves for Mumford's Maximally Flat Filter (Correspondence)." 1968 Transactions on Microwave Theory and Techniques 16.5 (May 1968 [T-MTT]): 316-318.

Mumford has published design tables for a class of maximally flat symmetric bandpass filters, composed of shorted quarter-wave stubs separated by quarter-wave lines. Schiffman has presented curves enabling the calculation of 3-dB bandwidth and insertion loss for the high-loss case. Because of the continued interest in these filters and their common use, we present complete insertion loss versus normalized frequency curves here for three to ten resonators, for all the cases considered by Mumford.

Abstracts

Mode Separation and Group Velocity at the n pi-Modes of a Dielectrically Loaded Slow Wave Structure (Correspondence)

D.R. McDiarmid. "Mode Separation and Group Velocity at the n pi-Modes of a Dielectrically Loaded Slow Wave Structure (Correspondence)." 1968 Transactions on Microwave Theory and Techniques 16.5 (May 1968 [T-MTT]): 318-319.

A new criterion is given for the elimination of a stopband (confluence) of a lossless, dielectrically loaded, periodic structure, which is excited in a TM mode. It is shown that this criterion is also valid when the structure is excited in a TE mode. The nonzero group velocity at the confluence point that results is discussed in terms of the wave impedance.

Abstracts

Bulk and Deposited Ferrite Isolators for Millimeter Maser Application (Correspondence)

B.J. Peyton, F.R. Arams, W. Wade and T. Collins. "Bulk and Deposited Ferrite Isolators for Millimeter Maser Application (Correspondence)." 1968 Transactions on Microwave Theory and Techniques 16.5 (May 1968 [T-MTT]): 319-320.

This correspondence reports data obtained the saturation magnetization and linewidth, at room and liquid helium temperatures, of ferrites examined as potential isolator materials for the 35.4- to 40-GHz tunable traveling-wave maser previously reported by Arams and Peyton. The Cr/sup 3+/:TiO/sub 2/ energy levels and E-plane isolator geometry dictated a 4 pi M/sub s/ and linewidth exceeding 2800 gauss and 1200 Oe, respectively, at 4.2°K, so that yttrium-iron garnet, used in microwave traveling-wave masers, could not be used as the isolator material.

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Contributors (May 1968 [T-MTT])

C.A. Burrus, Jr., H.-J. Butterweck, J.B. DaSilva, R.S. Elliott, G.I. Haddad, M.K. Krage and T.P. Lee. "Contributors (May 1968 [T-MTT])." 1968 Transactions on Microwave Theory and Techniques 16.5 (May 1968 [T-MTT]): 321-321.

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Computer Optimization of a Stabilizing Network for a Tunnel-Diode Amplifier

J.W. Bandler. "Computer Optimization of a Stabilizing Network for a Tunnel-Diode Amplifier." 1968 Transactions on Microwave Theory and Techniques 16.6 (Jun. 1968 [T-MTT]): 326-333.

Computer-aided direct search is a useful and flexible method of optimizing noncommensurate networks or networks for which exact synthesis theories culminating in some particular response are not available. It can accommodate network parameter constraints and unconventional performance specifications and is not accompanied by problems of component realizability. A simple form of direct search is applied in this paper to the design of a microwave network whose performance is optimized within certain specifications. The network is a stabilizing and biasing arrangement for a tunnel-diode amplifier operating in a reduced height S-band rectangular waveguide, and takes the form of a coaxial-line band-stop filter. Parameter constraints are inherent to the problem so they are taken into account. The requirements of stability and low noise broadband amplification in conjunction with the external circuitry impose nonsymmetrical response restrictions on the input resistance and reactance of the network. At the same time it is required to minimize the square of the input reactance at selected frequencies. No available exact synthesis of band-stop filters can solve this problem as presented here.

Abstracts

The Scattering of an Axial Cylindrical Surface Wave by a Perfectly Conducting Plane Annulus

E. Gillespie and J.J. Gustincic. "The Scattering of an Axial Cylindrical Surface Wave by a Perfectly Conducting Plane Annulus." 1968 Transactions on Microwave Theory and Techniques 16.6 (Jun. 1968 [T-MTT]): 334-341.

The scattering of an axial cylindrical surface wave by a conducting plane annulus coaxial with a Goubau line is investigated both theoretically and experimentally. An integral equation for the current induced on the annulus is developed and solved numerically. A novel approach is used to enforce the edge condition directly in the numerical solution. The computed magnitude of the current induced on a large annulus is plotted and compared with the current which would flow on a short circuit in order to demonstrate the effects of the edges of the annulus. Values of the reflection coefficients are calculated from the computed current distributions. Numerical results are presented and compared with experimental values measured on a Teflon coated aluminum rod. Annluses measuring up to one wavelength in radial width and positioned up to one wavelength above the dielectric are considered, and agreement between theory and experiment is found to be good. A thorough description of the experimental apparatus and measuring technique is presented.

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Losses in Microstrip

R.A. Pucel, D.J. Masse and C.P. Hartwig. "Losses in Microstrip." 1968 Transactions on Microwave Theory and Techniques 16.6 (Jun. 1968 [T-MTT]): 342-350.

Expressions are derived for the conductor loss in microstrip transmission lines. The formulas take into account the finite thickness of the strip conductor and apply to the mixed dielectric system. Good agreement with experimental data is obtained for rutile and alumina substrates.

Abstracts

Birefringent Filter for Millimeter Waves (Jun. 1968 [T-MTT])

B.M. Schiffman and L. Young. "Birefringent Filter for Millimeter Waves (Jun. 1968 [T-MTT])." 1968 Transactions on Microwave Theory and Techniques 16.6 (Jun. 1968 [T-MTT]): 351-360.

A scale model (f/sub 0/ =20 GH/sub z/ of a Solc-type birefringent wave filter for millimeter wavelengths is described. The filter consists of five cascaded identical half-wave plates, or crystals, each composed of an artificial anisotropic dielectric medium with its reference axis tilted at some prescribed angle to the plane of the input polarization. The design and analysis of an individual plate, using Collin's second-order theory of the birefringence of artificial anisotropic dielectrics, and the analysis of multielement filters (filters composed of many plates), aided by Evans' matrix method, are discussed. The experimental filter was tested in the range of 18 to 33 GHz, and its measured performance was found to compare well with the theoretical performance over a major portion of the range of frequencies used in the tests. A synthesis procedure for optimum (equal-ripple stopband) response multielement filters is given, together with tables of plate angles for such filters. In this procedure, the Dolph approximation and the Harris synthesis are combined.

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A Wideband Stripline Hybrid Ring (Correspondence)

S. March. "A Wideband Stripline Hybrid Ring (Correspondence)." 1968 Transactions on Microwave Theory and Techniques 16.6 (Jun. 1968 [T-MTT]): 361-361.

Although usually considered a narrow-band device, the "rat-race" hybrid can be broadbanded for good performance over an octave by incorporating several design changes. The limiting factor in the hybrid-ring coupler of Fig. 1 is the three-quarter wavelength section, which restricts the useful frequency range for the 180° hybrid to f/sub 0/±0.23f/sub 0/, where f/sub 0/ is the center frequency in the band of interest. The conventional ring configuration exhibits -3.0 dB of coupling when the impedance of each of the ring segments, Z/sub r/, is /spl radic/2 Z/sub 0/, where Z/sub 0/ is the characteristic impedance of both the input and output lines.

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Propagation of TE Modes in Dielectric Loaded Waveguides--Part II: Numerical Results (Correspondence)

R. Seckelmann. "Propagation of TE Modes in Dielectric Loaded Waveguides--Part II: Numerical Results (Correspondence)." 1968 Transactions on Microwave Theory and Techniques 16.6 (Jun. 1968 [T-MTT]): 362-368.

This correspondence furnishes, in the form of computer-printed tables, normalized cutoff frequencies and propagation numbers for TE/sub n0/ modes in waveguides with dielectric slabs. The theory and graphical presentation of some of these results, as well as of selected secondary results, such as field distributions and impedances, were given in a previous paper.

Abstracts

Oscillator Noise Cancellation in Hybrid Mixers (Correspondence)

J. Lange. "Oscillator Noise Cancellation in Hybrid Mixers (Correspondence)." 1968 Transactions on Microwave Theory and Techniques 16.6 (Jun. 1968 [T-MTT]): 368-369.

Low-noise mixers frequently employ two diodes and a magic-T in a "balanced mixer" configuration to cancel oscillator noise, i.e., noise caused by spurious oscillator output at or near the signal or image frequencies (see Fig. 1). When working in stripline, the most convenient "balanced mixer" configurations use 3-dB edge-coupled or branch-line directional couplers. These are 90° hybrids, not 180° hybrids like the magic-T. The question is whether the oscillator noise still cancels. As shown below, it does so for any hybrid, if the phase difference between the two output ports is the same at the signal, local oscillator, and image frequencies.

Abstracts

Concentric Spherical Resonator Eigenfrequencies (Correspondence)

D.L. Rode. "Concentric Spherical Resonator Eigenfrequencies (Correspondence)." 1968 Transactions on Microwave Theory and Techniques 16.6 (Jun. 1968 [T-MTT]): 369-372.

A detailed tabulation of the resonant frequencies for two concentric spheres is presented. These are the roots of the given transcendental equations for TE- and TM-type modes which follow from the boundary conditions at a perfectly conducting surface. All TE-mode frequencies are raised by the presence of the inner sphere while those for TM modes may be raised or lowered, depending upon the ratio of the diameters. Microwave breakdown and heating of a plasma have been enhanced by the use of a TM concentric spherical mode as reported.

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Abstracts

Design Consideration for Circular Bend of Reflecting Beam Waveguide (Correspondence)

T. Yamasaki and Y. Nakanishi. "Design Consideration for Circular Bend of Reflecting Beam Waveguide (Correspondence)." 1968 Transactions on Microwave Theory and Techniques 16.6 (Jun. 1968 [T-MTT]): 373-374.

This correspondence presents a design consideration for the circular bend section of the reflecting beam waveguide, where the radius of curvature of the bend section is an arbitrary given number, and for the connection between the straight section and the circular bend section.

Abstracts

The Effect of Paracitic Elements on Potential Stability Criteria for Tunnel Diodes (Correspondence)

J. Markowski. "The Effect of Paracitic Elements on Potential Stability Criteria for Tunnel Diodes (Correspondence)." 1968 Transactions on Microwave Theory and Techniques 16.6 (Jun. 1968 [T-MTT]): 374-374.

The idea of tunnel-diode potential stability was first introduced by Smilan and Youla. In their work the conditions for potential stability of the tunnel diode are computed on the basis of an equivalent circuit consisting of 1) negative resistance -R, 2) junction capacitance C/sub d/, 3) series inductance L/sub d/, and 4) junction spreading resistance r. Scanlan and Lim derived the conditions the tunnel-diode potential stability taking into account additionally the package capacitance C/sub s/. They neglected, however, the spreading resistance r. The formula for the stability conditions derived in their paper which gives the dependence between the package capacitance and the series inductance has the form (using Scanlan and Lim's notation) $C(L^2 - 5L + 5) > -5$.

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The Negative Capacitor, an Impedance Matching Element for Dielectric-Filled Transmission-Line (Addendum)

A.J. Kelly. "The Negative Capacitor, an Impedance Matching Element for Dielectric-Filled Transmission-Line (Addendum)." 1968 Transactions on Microwave Theory and Techniques 16.6 (Jun. 1968 [T-MTT]): 374-374.

On revising the above correspondence for publication, I inadvertently deleted the acknowledgment section. Mr. Harold A. Wheeler suggested this area of study, for a master's thesis, while I was a member of the staff of Wheeler Labs.; the experimental portion of the report project was conducted using the facilities of Wheeler Labs. Dr. J. W. E. Griemsmann was the report advisor at Polytechnic Institute of Brooklyn. I am deeply indebted to both of these gentlemen for their advice and guidance.

Abstracts

Microwave Abstracts (Jun. 1968 [T-MTT])

"Microwave Abstracts (Jun. 1968 [T-MTT])." 1968 Transactions on Microwave Theory and Techniques 16.6 (Jun. 1968 [T-MTT]): 375-377.

Based on technical merit and timeliness, microwave papers in journals published outside the United States have been selected and compiled below, many with annotations. Reprints of the papers may be obtained by writing directly to the author or to the source quoted.

Abstracts

Contributors (Jun. 1968 [T-MTT])

J.W. Bandler, E.S. Gillespie, J.J. Gustincic, C.P. Hartwig, D. Masse, R.A. Pucel, B.M. Schiffman and L. Young. "Contributors (Jun. 1968 [T-MTT])." 1968 Transactions on Microwave Theory and Techniques 16.6 (Jun. 1968 [T-MTT]): 377-378.

Abstracts

Information for Authors (Jun. 1968 [T-MTT])

"Information for Authors (Jun. 1968 [T-MTT])." 1968 Transactions on Microwave Theory and Techniques 16.6 (Jun. 1968 [T-MTT]): 379-379.

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Membership Application (Jun. 1968 [T-MTT])

"Membership Application (Jun. 1968 [T-MTT])." 1968 Transactions on Microwave Theory and Techniques 16.6 (Jun. 1968 [T-MTT]): 380-380.

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Table of Contents (Jul. 1968 [T-MTT])

"Table of Contents (Jul. 1968 [T-MTT])." 1968 Transactions on Microwave Theory and Techniques 16.7 (Jul. 1968 [T-MTT] (Special Issue on Microwave Integrated Circuits)): 381-381.

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Editor's Notice (Jul. 1968 [T-MTT])

S. Okwit. "Editor's Notice (Jul. 1968 [T-MTT])." 1968 Transactions on Microwave Theory and Techniques 16.7 (Jul. 1968 [T-MTT] (Special Issue on Microwave Integrated Circuits)): 382-382.

This Transactions issue is a first in joint sponsorship within IEEE. It involved the coordinated publication efforts of the IEEE Transactions on Electron Devices, the IEEE Journal of Solid-State Circuits, and the IEEE Transactions on Microwave Theory and Techniques. The involvement of three distinct publications demonstrates the wide interest of the technical community in this new and challenging field of microwave integrated circuits. It also shows the accelerated evolution of a technology when broad and varied disciplines channel their efforts in a common direction.

Abstracts

Foreword (Jul. 1968 [T-MTT])

W.J. Edwards. "Foreword (Jul. 1968 [T-MTT])." 1968 Transactions on Microwave Theory and Techniques 16.7 (Jul. 1968 [T-MTT] (Special Issue on Microwave Integrated Circuits)): 383-383.

The Subject of this issue is the integration of microwave circuits--a method for the construction of microwave circuits where photolithographic and chemical processes are the dominant fabrication techniques. Concerted efforts in this area began in 1964. Uhlir's article on the "Microwave Applications of Integrated Circuit Techniques" (IEEE Proceedings, December, 1964) and government sponsored efforts helped focus attention on the possibility of integrating microwave circuits. At that time there were few encouraging signs to indicate that microwave integration could provide the performance and cost advantages that were then projected. Few quality components were available in compatible packages, the beam-lead technology was just emerging, and measurements on large area Schottky barrier diodes at 900 MHz only indicated that they might be likely substitutes for point contact diodes.

Abstracts

Integrated Microwave Modules--A Prospectus

W.M. Webster. "Integrated Microwave Modules--A Prospectus." 1968 Transactions on Microwave Theory and Techniques 16.7 (Jul. 1968 [T-MTT] (Special Issue on Microwave Integrated Circuits)): 384-388.

Applications of monolithic and hybrid semiconductor circuit technologies to microwaves are discussed from a semitechnical and economic viewpoint. Technical feasibility of performing nearly all functions through millimeter waves is foreseen. Economic success, however, is less tangible and depends mainly on two factors: the willingness of systems people to trade increased initial cost for greatly decreased maintenance cost and the magnitude of the requirements for electronically steered antennas. The author's estimates of the business potential are discussed.

Abstracts

X-Band Integrated Circuit Mixer with Reactively Terminated Image (Jul. 1968 [T-MTT])

K.M. Johnson. "X-Band Integrated Circuit Mixer with Reactively Terminated Image (Jul. 1968 [T-MTT])." 1968 Transactions on Microwave Theory and Techniques 16.7 (Jul. 1968 [T-MTT] (Special Issue on Microwave Integrated Circuits)): 388-397.

An X-band mixer using GaAs Schottky barrier diodes with a thin-film 500-MHz IF preamplifier was developed using hybrid microwave integrated circuit techniques. The balanced mixer had filters to provide a short circuit at the image frequency. The entire mixer preamplifier occupied an area of only 0.38 square inches and had a noise figure of 6.7 dB which corresponded quite closely to the theoretical noise figure considering all losses. The thin-film IF amplifier alone had a 2.2-dB noise figure and the mixer IF amplifier coupling network had a loss of 0.4 dB.

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Abstracts

Hybrid Integrated Lumped-Element Microwave Amplifiers

M. Caulton, S.P. Knight and D.A. Daly. "Hybrid Integrated Lumped-Element Microwave Amplifiers." 1968 Transactions on Microwave Theory and Techniques 16.7 (Jul. 1968 [T-MTT] (Special Issue on Microwave Integrated Circuits)): 397-404.

This paper describes the development of microwave lumped-element thin-film amplifiers. The basic design philosophy underlying lumped inductors and capacitors at microwave f requencies is reviewed, showing how Q's of 100 are achieved. A variety of tunable input, output, and interstage integrated lumped-element networks for transistor amplifiers were fabricated. The gain and efficiency of 2-GHz class-C operated transistors mounted in these circuits were comparable with the beat performance achieved by the same transistors in less lossy coaxial circuits. The measured losses (1.2 dB) at 2 GHz were very close to those calculated using the design parameters. Single-stage amplifiers at 2 GHz achieved one watt of output power with 4 dB of gain. At somewhat lower power levels more than 6 dB of gain was achieved. The circuits allowed the operation of low-power level class-A amplifiers with over 13 dB of gain. Cascaded operation yielded more than 17 dB of gain with 0.8 watts of CW power. It is concluded that lumped elements can be fabricated by thin-film technology and will play an important role in microwave integrated circuits.

Abstracts

Ferrite Elements for Hybrid Microwave Integrated Systems

J.L. Allen and D.R. Taft. "Ferrite Elements for Hybrid Microwave Integrated Systems." 1968 Transactions on Microwave Theory and Techniques 16.7 (Jul. 1968 [T-MTT] (Special Issue on Microwave Integrated Circuits)): 405-411.

Complete realization of the potentialities of hybrid microwave integrated circuits will require both semiconductor and ferrite elements. This paper presents performance data for several microstrip ferrite devices that can play an important role in the exploitation of microwave integrated circuits. Data on both fixed-field and latched microstrip junction circulators are given including a fixed-field circulator with less than 0.4-dB loss and greater than 20-dB isolation over the 6.5- to 9.3-GHz band. The characteristics of microstrip meander-line phasers are discussed, and a simple, rugged technique for fabricating single-crystal YIG devices by embedding the YIG element in the substrate is presented.

Abstracts

Thin Ferrite Devices for Microwave Integrated Circuits

G.T. Roome and H.A. Hair. "Thin Ferrite Devices for Microwave Integrated Circuits." 1968 Transactions on Microwave Theory and Techniques 16.7 (Jul. 1968 [T-MTT] (Special Issue on Microwave Integrated Circuits)): 411-420.

This paper is intended as a review of developments which allow ferrite materials in a planar geometry to be used in the realization of magnetic devices which are compatible in form with other microwave integrated circuits. These devices include phase shifters (reciprocal and nonreciprocal), latching circulators, isolators, and phase and amplitude modulators. The application of some of these devices is demonstrated in the form of electronically steerable array antennas.

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A High-Performance Integrated Microwave Circuit Frequency Quadrupler

K.M. Johnson. "A High-Performance Integrated Microwave Circuit Frequency Quadrupler." 1968 Transactions on Microwave Theory and Techniques 16.7 (Jul. 1968 [T-MTT] (Special Issue on Microwave Integrated Circuits)): 420-424.

An S- to X-band frequency quadrupler was developed with a 4.0-dB conversion loss and 11-percent bandwidth using hybrid integrated microwave circuit techniques. The multiplier has a low-pass transforming filter on the input and a bandpass filter consisting of half-wavelength lines edge coupled over quarter wavelengths on the output. Design curves for the bandpass filter are given for ceramic microstrip. Two beam-lead varactors were used in the multiplier giving it an input power-handling capability of 3-watts peak power.

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Design Considerations for an Integrated 1.8-GHz Parametric Amplifier

P. Bura, R. Camisa, W.Y. Pan, S. Yuan and A. Block. "Design Considerations for an Integrated 1.8-GHz Parametric Amplifier." 1968 Transactions on Microwave Theory and Techniques 16.7 (Jul. 1968 [T-MTT] (Special Issue on Microwave Integrated Circuits)): 424-428.

A hybrid-integrated parametric amplifier has been fabricated in a microstrip transmission-line configuration. General design considerations and their implementation in a microstrip medium are discussed. The amplifier exhibited a power gain of 10 dB and 50-MHz half-power bandwidth with a noise figure of 2.0 dB. It was pumped at X-band frequency and required only 10 mW of pump power. The integrated pump source consisted of the transistor oscillator and a varactor quadrupler stage.

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Computer Aided Design of Wide-Band Integrated Microwave Transistor Amplifiers on High Dielectric Substrates

V.G. Gelnovatch and T.F. Burke. "Computer Aided Design of Wide-Band Integrated Microwave Transistor Amplifiers on High Dielectric Substrates." 1968 Transactions on Microwave Theory and Techniques 16.7 (Jul. 1968 [T-MTT] (Special Issue on Microwave Integrated Circuits)): 429-439.

The problem of wide bandwidth and flat in-band gain response for microwave transistor amplifiers has been reduced to the optimization of a number of important variables from computer prepared design charts. Through the general flexibility of the computer-generated data, a large variety of amplifier responses are possible using distributed circuit matching networks. As experimental verification of the overall design procedure, single-stage and two-stage octave wide transistor amplifiers were fabricated on 1inch by 1inch and 1inch by ½ inch 20 mil thick alumina, respectively. The experimental data gained from these units showed excellent correlation with the computer predicted response.

Abstracts

An Accurate Calculation of Uniform Microstrip Transmission Lines

H.E. Stinehelfer, Sr.. "An Accurate Calculation of Uniform Microstrip Transmission Lines." 1968 Transactions on Microwave Theory and Techniques 16.7 (Jul. 1968 [T-MTT] (Special Issue on Microwave Integrated Circuits)): 439-444.

An analytical program for calculating the field distribution about a microstrip transmission line bounded by a shielding wall is used to calculate the impedance, velocity, and attenuation parameters. The program input parameters are the dimensions of the strip and shielding wall and the relative dielectric constant of the substrate material. The field distribution about the strip is integrated to find the charge density on the strip and walls with and without the dielectric substrate. From these two calculations, the relative velocity and impedance can be calculated.

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Abstracts

Optimization of Diode Structures for Monolithic Integrated Microwave Circuits

B.W. Battershall and S.P. Emmons. "Optimization of Diode Structures for Monolithic Integrated Microwave Circuits." 1968 Transactions on Microwave Theory and Techniques 16.7 (Jul. 1968 [T-MTT] (Special Issue on Microwave Integrated Circuits)): 445-450.

Device requirements of a medium power Ku-band reflective phase shifter are reviewed indicating a requirement for a diode with a 4-Terrahertz cut-off frequency. Various structures are examined to test their suitability for integration and feasibility for meeting specifications. A "pocket version" of a surface oriented device design is chosen and described. It is shown to meet or exceed all electrical requirements while providing for compatibility with final integration into the circuit.

Abstracts

GaAs Integrated Microwave Circuits

E.W. Mehal and R.W. Wacker. "GaAs Integrated Microwave Circuits." 1968 Transactions on Microwave Theory and Techniques 16.7 (Jul. 1968 [T-MTT] (Special Issue on Microwave Integrated Circuits)): 451-454.

GaAs has many desirable features that make it most useful for microwave and millimeter-wave integrated circuits. The process of selective epitaxial depositions of high purity single-crystal GaAs with various doping concentrations into semi-insulating GaAs substrates has been developed. These high-resistivity substrates (>10/sup 6/ ohm · cm) provide the electrical isolation between devices, eliminating the difficulties and deficiencies normally encountered in trying to obtain isolation with dielectrics, back-etching, p-n junctions, etc. This monolithic approach to integrated circuits thus allows for improved microwave performance from the devices since parasitic are reduced to a minimum. Planar Gunn oscillators and Schottky barrier diodes have been fabricated for use in a completely monolithic integrated millimeter wave (94 GHz) receiving front end. The Gunn oscillators are made in a sandwich-type structure of three selective deposits whose carrier concentrations are approximately 10/sup 18/ - 10/sup/15/ - 10/sup 18/ cm/sup -3/. The Schottky diodes consist of two deposits with concentrations of 10/sup 18/ and 10/sup 17/ cm /sup -3/. The Schottky contact is formed by evaporating Mo-Au onto the 10/sup 17/cm/sup -3/ deposits; all ohmic contacts are on the surface and are alloyed to the N/sup +/ regions.

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Millimeter-Wave Integrated Circuits (Jul. 1968 [T-MTT])

S. Mao, S. Jones and G.D. Vendelin. "Millimeter-Wave Integrated Circuits (Jul. 1968 [T-MTT])." 1968 Transactions on Microwave Theory and Techniques 16.7 (Jul. 1968 [T-MTT] (Special Issue on Microwave Integrated Circuits)): 455-461.

Monolithic millimeter-wave integrated circuits have been designed and fabricated on semi-insulating GaAs substrates using microstrip transmission lines. Circuits using hybrid techniques have also been constructed on quartz and ceramics. This paper shows that microstrip-line integrated circuits are feasible at millimeter-wave frequencies. Circuit functions have been constructed and tested in the 25- to 100-GHZ range. The loss in microstrip line on semi-insulating GaAs was found to be less than 0.3 dB//lambda/. Couplers from waveguide to microstrip have been made with transmission losses less than 0.5 dB. Monolithic integrated detectors showed 5-dB better sensitivity than a 1N53 diode in a Philips detector mount. Monolithic diodes delivered 1.5 mW at 28 GHz. The results are encouraging and a fully monolithic integrated receiver is under development.

Abstracts

Design of Digital Loaded-Line Phase-Shift Networks for Microwave Thin-Film Applications

F.L. Opp and W.F. Hoffman. "Design of Digital Loaded-Line Phase-Shift Networks for Microwave Thin-Film Applications." 1968 Transactions on Microwave Theory and Techniques 16.7 (Jul. 1968 [T-MTT] (Special Issue on Microwave Integrated Circuits)): 462-468.

This paper describes the design approach, fabrication techniques, and electrical performance for two types of microwave hybrid thin-film phase shifters. Emphasis is placed on the practical aspects of the overall design and fabrication. A simplified set of design equations for loaded-line phase-shift networks is presented and divided into three categories based on the type of loading employed. The two circuits presented are a 4-bit 90° network employing single-section multibits to minimize physical size, and a 4-bit 360° network employing the 45° section as a basic building block.

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Abstracts

An Evaluation of Materials and Processes for Integrated Microwave Circuits

F.Z. Keister. "An Evaluation of Materials and Processes for Integrated Microwave Circuits." 1968 Transactions on Microwave Theory and Techniques 16.7 (Jul. 1968 [T-MTT] (Special Issue on Microwave Integrated Circuits)): 469-475.

This paper presents an evaluation of materials and processes applicable to the fabrication of hybrid microstrip microwave circuits. Substrate materials evaluated included aluminas, beryllias, quartz, and glass of varying purities and surface finishes. Conductor materials evaluated included silver, copper, gold, and aluminum. Fabrication processes studied included vacuum deposition, sputtering, electroless and electroplating, thick-film screening and firing, and photoetching. Sapphire and high-purity alumina (99.5 percent pure or better) substrates were found superior as substrates for microstrip circuits. Conductor materials and processing methods found best were 1) vacuum deposited chromium-gold thin film which was gold electroplated and photoetched; 2) thick-film silver which was photoetched to delineate the microwave pattern.

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A 3-db Directional Coupler for Microwave Integrated Circuits (Correspondence)

J.E. Morris. "A 3-db Directional Coupler for Microwave Integrated Circuits (Correspondence)." 1968 Transactions on Microwave Theory and Techniques 16.7 (Jul. 1968 [T-MTT] (Special Issue on Microwave Integrated Circuits)): 476-477.

A procedure for designing quarter-wavelength 3-dB directional couplers is described which utilizes a perturbation technique to reduce the number of experimental models needed during the development. Limitations caused by unequal odd and even mode phase velocities and junction parasitics are discussed. The use of thin-film conductors on quartz and glazed ceramic gives a coupling accuracy better than 3.0 ± 0.1 dB and an isolation greater than 32 dB with worst-case tolerances.

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A Multistub Filter for Microstripline (Correspondence)

W. Atwood and H.E. Stinehelfer, Sr.. "A Multistub Filter for Microstripline (Correspondence)." 1968 Transactions on Microwave Theory and Techniques 16.7 (Jul. 1968 [T-MTT] (Special Issue on Microwave Integrated Circuits)): 477-480.

A maximally flat multistub filter was designed using both /spl lambda//4 shorted and /spl lambda//2 open stubs and constructed on ceramic substrate using microstrip transmission lines.

Abstracts

High-Power 1-GHz Coplanar Gunn-Effect Oscillators (Correspondence)

L.E. Norton, R.E. Enstrom and I.J. Hegyi. "High-Power 1-GHz Coplanar Gunn-Effect Oscillators (Correspondence)." 1968 Transactions on Microwave Theory and Techniques 16.7 (Jul. 1968 [T-MTT] (Special Issue on Microwave Integrated Circuits)): 480-481.

High peak pulsed output power (up to 100 watts), co-planar, L-band (1 GHz), epitaxial-layer Gunn oscillators are described. Particular emphasis has been given to minimizing surface damage and to effective heat dissipation. These high-power oscillators have been used in both coaxial and stripline circuits. The latter are adaptable to integrated circuitry.

Abstracts

Hybrid Integrated L-Band Transmitter (Correspondence)

A. Presser, E. Belohoubek and H. Johnson. "Hybrid Integrated L-Band Transmitter (Correspondence)." 1968 Transactions on Microwave Theory and Techniques 16.7 (Jul. 1968 [T-MTT] (Special Issue on Microwave Integrated Circuits)): 482-483.

Microstrip circuit techniques are applied to the development of a small, light-weight, ruggedized, L-band 200-mW oscillator. Performance data of the oscillator are given and two applications, a radiosonde and a projectile telemetry transmitter, are described.

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Abstracts

Recent Experimental Work on Silicon Microstrip Microwave Transmission Lines (Correspondence)

F.E. Emery and P.L. Noel. "Recent Experimental Work on Silicon Microstrip Microwave Transmission Lines (Correspondence)." 1968 Transactions on Microwave Theory and Techniques 16.7 (Jul. 1968 [T-MTT] (Special Issue on Microwave Integrated Circuits)): 483-484.

In recent years a great deal of literature has become available on microstrip transmission lines, generated by interest in microwave integrated circuitry. At high frequencies, microstrip on silicon is of interest so that the microwave circuits may reconstructed on the same material as the active devices.

Abstracts

A Microstrip Nonreciprocal Tunable YIG Filter (Correspondence)

C.K. Greene. "A Microstrip Nonreciprocal Tunable YIG Filter (Correspondence)." 1968 Transactions on Microwave Theory and Techniques 16.7 (Jul. 1968 [T-MTT] (Special Issue on Microwave Integrated Circuits)): 484-486.

A nonreciprocal tunable YIG filter in a microstrip configuration has been constructed which makes use of a novel method of generating a circularly polarized field in the plane of a microstrip circuit. Nonreciprocities in excess of 40 dB have been obtained at X band with relatively low insertion loss and VSWR.

Abstracts

Contributors (Jul. 1968 [T-MTT])

J.L. Allen, B.W. Battershall, A. Block, P. Bura, T.F. Burke, R. Camisa, M. Caulton, D.A. Daly, S.P. Emmons, V.G. Gelnovatch, H.A. Hair, W.F. Hoffman, K.M. Johnson, S. Jones, F.Z. Keister, S.P. Knight, S. Mao, E.W. Mehal, F.L. Opp, W.Y. Pan, G.T. Roome, H.E. Stinehelfer, D.R. Taft, G.D. Vendelin, R.W. Wacker, W.M. Webster and S. Yuan. "Contributors (Jul. 1968 [T-MTT])." 1968 Transactions on Microwave Theory and Techniques 16.7 (Jul. 1968 [T-MTT] (Special Issue on Microwave Integrated Circuits)): 486-489.

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"Information for Authors (Jul. 1968 [T-MTT])." 1968 Transactions on Microwave Theory and Techniques 16.7 (Jul. 1968 [T-MTT] (Special Issue on Microwave Integrated Circuits)): 490-490.

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Membership Application (Jul. 1968 [T-MTT])

"Membership Application (Jul. 1968 [T-MTT])." 1968 Transactions on Microwave Theory and Techniques 16.7 (Jul. 1968 [T-MTT] (Special Issue on Microwave Integrated Circuits)): 491-491.

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Forward and Backward Scattered Modes in Multimode Nonuniform Transitions

C.C.H. Tang. "Forward and Backward Scattered Modes in Multimode Nonuniform Transitions." 1968 Transactions on Microwave Theory and Techniques 16.8 (Aug. 1968 [T-MTT]): 494-502.

Analyses previously published on the subject of mode conversion consider only the forward scattered modes. The present paper investigates both the forward and backward scattered modes at frequencies from cutoff to far away from cutoff in a multimode nonuniform waveguide. The four coupled telegraphist's equations with varying coefficients are transformed into the form of coupled Volterra integral equations of the second kind and these integral equations are solved by an iteration method. The solutions are valid for all frequencies from cutoff to far away from cutoff. For uniform waveguides the solutions correctly reduce to those of the original forward traveling launching mode. The solutions also show the characteristics of "propagation" in the tapered cutoff region of the waveguide. The accuracy of the series solution is discussed, and possible wide applications of the results to a variety of problems are mentioned.

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Abstracts

Wave Scattering in Nonuniform Waveguides with Large Flare Angles and Near Cutoff

E. Bahar. "Wave Scattering in Nonuniform Waveguides with Large Flare Angles and Near Cutoff." 1968 Transactions on Microwave Theory and Techniques 16.8 (Aug. 1968 [T-MTT]): 503-510.

A set of coupled first-order differential equations for the wave amplitudes in nonuniform waveguides is developed. The coupling coefficients are regarded as differential transmission and reflection scattering coefficients between two adjacent elementary radial waveguide sections. The analysis is an extension of an earlier quasi-optical solution. This set of coupled equations is compared with the familiar generalized telegraphist's equations which may be derived by considering the nonuniform waveguide to consist of elementary rectangular waveguide sections. The equations for the wave amplitudes derived in this paper are less coupled than the commonly used telegraphist's equations, and they may also be applied to waveguides with large flare angles and in regions at which the waveguide modes are at their respective cutoff cross sections.

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Uniform Transmission Line Equivalence of Cascaded Exponential Lines

D. Das and O.P. Rustogi. "Uniform Transmission Line Equivalence of Cascaded Exponential Lines." 1968 Transactions on Microwave Theory and Techniques 16.8 (Aug. 1968 [T-MTT]): 511-516.

The possibility of using cascaded sections of exponential transmission line in place of uniform transmission line is discussed. This makes it possible to reduce element lengths without changing the impedance level at the input and output terminals. Relevant design formulas are derived.

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Abstracts

Symmetrically Truncated Right-Angle Corners in Parallel-Plate and Rectangular Waveguides

J.J. Campbell and W.R. Jones. "Symmetrically Truncated Right-Angle Corners in Parallel-Plate and Rectangular Waveguides." 1968 Transactions on Microwave Theory and Techniques 16.8 (Aug. 1968 [T-MTT]): 517-529.

The symmetrically truncated right angle E-plane corner is investigated as a function of the position of the truncation plane. The problem is treated by placing electric and magnetic walls in the plane of symmetry of the bend and solving the resulting boundary value problems assuming an incident TEM mode in parallel-plate waveguide. The results are directly applicable to the same type of corner in rectangular waveguide. In analyzing the problem an infinite set of first order differential equations arise which are appropriately truncated and solved on an electronic computer by means of a fourth order Runge-Kutta scheme.

Abstracts

Variational Method for the Analysis of Microstrip-Like Transmission Lines

E. Yamashita. "Variational Method for the Analysis of Microstrip-Like Transmission Lines." 1968 Transactions on Microwave Theory and Techniques 16.8 (Aug. 1968 [T-MTT]): 529-535.

A theoretical method is presented by which microstrip-like transmission lines can be analyzed. These transmission lines are characterized by conducting strips, large ground planes, multi-dielectric-layer insulation, and planar geometry. The method is essentially based on a variational calculation of the line capacitance in the Fourier-transformed domain and on the charge density distribution as a trial function. A shielded double-layer microstrip line is analyzed by this method. Derived formulas for this structure are also applicable to simpler structures: a double-layer microstrip line, a shielded microstrip line, and a microstrip line. The calculated values of the line capacitance and the guide wavelength are compared with the measured values where possible. Oxide-layer effects on a silicon microstrip line and shielding effects on a sapphire microstrip line are also discussed based on this theory. The limitations and possible applications of this method are described.

Abstracts

Equivalent Circuit of the Bolometer Detector

S.B. Cohn. "Equivalent Circuit of the Bolometer Detector." 1968 Transactions on Microwave Theory and Techniques 16.8 (Aug. 1968 [T-MTT]): 536-541.

A small-signal dynamic equivalent circuit is established for the output voltage of a dc-biased bolometer (barretter) detector. The circuit consists of a voltage generator /spl upsi//sub g/, whose output is an undistorted replica of the incident RF-power modulation envelope, followed by a series resistor R/sub 1/ of dynamic origin, a shunt capacitor C that represents heat storage in the bolometer wire, and a series resistor R/sub 0/ equal to the dc resistance, usually 200 ohms. The resistance R/sub 1/ is independent of signal level, and is typically about 220 ohms for an 8.75-mA bolometer and about 120 ohms for a 4.5-mA bolometer. At a modulation frequency f/sub m/ near 0 Hz, the equivalent audio source impedance of the bolometer is R/sub 1/ +R/sub 0/. The common belief that the source impedance is R/sub 0/ in the weak-signal case is, therefore, refuted. Formulas are derived giving v/sub g/ / /P/sub RF/ and R/sub 1/ as functions of basic, easily determined bolometer parameters. The time constant for open-circuit load is /spl tau//sub oc/= R/sub 1/C, where /spl tau//sub oc/ is determined best by measurement, since catalog values of /spl tau//sub oc/ often are seriously in error. The capacitance is C=/spl tau//sub oc/ / /R/sub 1/. With one type of bolometer /spl tau//sub oc/ measures about 110 /spl mu/s, while various catalogs state values of 250 to 350 /spl mu/s. The equivalent circuit is confirmed quantitatively by measurements of output voltage and source impedance versus modulation frequency.

Abstracts

A 1200-Megabit per Second Microwave-Carrier Gray-Code Analog-to-Digital Converter

R.E. Fisher. "A 1200-Megabit per Second Microwave-Carrier Gray-Code Analog-to-Digital Converter." 1968 Transactions on Microwave Theory and Techniques 16.8 (Aug. 1968 [T-MTT]): 541-547.

One coder stage of a previously reported 1200-megabit per second microwave-carrier gray-code analog-to-digital converter has been constructed. This stage, using a 9-GHz carrier, can encode analog signal at a 240-MHz rate, thereby giving an equivalent 5-stage bit rate of 1200 Mbit/s.

Abstracts

A Molecular Resonance AFC System for Millimeter Oscillators

M.E. Cram and D.T. Paris. "A Molecular Resonance AFC System for Millimeter Oscillators." 1968 Transactions on Microwave Theory and Techniques 16.8 (Aug. 1968 [T-MTT]): 548-553.

An investigation was made of a millimeter-wave oscillator AFC system utilizing the inherent stability of a molecular rotational transition as a reference. A unique frequency discriminator, based on Stark modulation of the J=1 --> 2 transition of methyl fluoride, CH/sub 3/F, was used to stabilize a reflex klystron. The stabilized frequency was approximately 102.2 GHz. Experimental data indicate that a closed-loop stability of about one part in 10/sup 7/ per hour was achieved. The long-term stability thus obtained is comparable to that of a phase-locked oscillator utilizing a low-frequency quartz crystal oscillator as a reference.

Abstracts

A Note on the Synthesis of Coupled-Line Directional Couplers and All-Pass Networks (Correspondence)

W. Steenaart. "A Note on the Synthesis of Coupled-Line Directional Couplers and All-Pass Networks (Correspondence)." 1968 Transactions on Microwave Theory and Techniques 16.8 (Aug. 1968 [T-MTT]): 554-555.

A symmetrical homogeneous coupled transmission-line pair may be terminated as a directional coupler or as an all-pass section. A combination of several of these coupled-line elements in cascade, each of constant characteristic impedance, may be terminated in the same way, and the following remarks apply either to a single element or to a cascade of elements, not necessarily of equal length.

Abstracts

Characteristic Impedances of Generalized Rectangular Transmission Lines (Correction)

A.A. Clark. "Characteristic Impedances of Generalized Rectangular Transmission Lines (Correction)." 1968 Transactions on Microwave Theory and Techniques 16.8 (Aug. 1968 [T-MTT]): 555-555.

I believe a few minor typographical errors have unfortunately occurred in this paper, and I respectfully submit the following corrections.

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Abstracts

The Effectiveness of Component Elements in Commensurate Linelength Filters (Correspondence)

M.C. Horton and R.J. Wenzel. "The Effectiveness of Component Elements in Commensurate Linelength Filters (Correspondence)." 1968 Transactions on Microwave Theory and Techniques 16.8 (Aug. 1968 [T-MTT]): 555-557.

In a recent correspondence, Fraiture and Neirynck have described the improved performance and more convenient element values that can be achieved by incorporating unit elements (ue's) that contribute to the response characteristic in an elliptic-function-type commensurate linelength filter. The purpose of this correspondence is to demonstrate that, for elliptic-function-type filters incorporating unit elements, the filtering potential of a ue used in cascade varies with filter bandwidth and is less effective than that of stub-type elements in achieving rapid cutoff response.

Abstracts

High-Power Y-Junction E-Plane Circulator (Correspondence)

W.H. Wright, Jr. and J.W. McGowan. "High-Power Y-Junction E-Plane Circulator (Correspondence)." 1968 Transactions on Microwave Theory and Techniques 16.8 (Aug. 1968 [T-MTT]): 557-559.

A symmetrical, Y-junction, E-plane circulator, capable of handling in excess of 500 kW peak and 670 watts average power, is described. The circulator operates at a frequency of 9375 MHz. A circular hole with a length equal to the broad dimension of the waveguide forms the junction of the three waveguide ports. Ferrite discs are mounted at the center of the junction on the narrow wall of the waveguide. The magnetic biasing field is applied along the axis of the discs. Materials tested were pure, 2 percent dysprosium-doped, 4 percent dysprosium-doped, 8 percent dysprosium-doped, and 4 percent dysprosium with 30 percent gadoliohium-doped polycrystalline YIG. The insertion loss and the isolation at the power levels mentioned depended on the material used. Measurements at high power showed an insertion loss of 0.8 dB and an isolation of 15 to 16 dB to be the best obtainable results using 4 percent dysprosium with 30 percent gadolinium-doped material. Data on insertion loss as a function of peak power are presented.

Abstracts

Gap Spacing for Narrow-Bandwidth End-Coupled Symmetric Stripline Filters (Correspondence)

J.K. Richardson. "Gap Spacing for Narrow-Bandwidth End-Coupled Symmetric Stripline Filters (Correspondence)." 1968 Transactions on Microwave Theory and Techniques 16.8 (Aug. 1968 [T-MTT]): 559-560.

The gap spacing for an end-coupled symmetric stripline filter (see Figs. 1, 2 [1]) may be determined as a function of the ground-plane spacing, center wavelength, and a normalized bandwidth parameter, utilizing the equivalent circuit of the gap between resonator strips (Fig. 3). It will be shown that the coupling between strips is accurately represented by a series susceptance for the ratio S/D not exceeding ½, but for S/D greater than unity, it is not always possible to accurately design end-coupled symmetric stripline filters utilizing the equivalent circuit of the coupling gap.

Abstracts

Microstrip Filters and Couplers (Correspondence)

D. Kelley, A.G. Kramer and F.G. Willwerth. "Microstrip Filters and Couplers (Correspondence)." 1968 Transactions on Microwave Theory and Techniques 16.8 (Aug. 1968 [T-MTT]): 560-562.

Some results are presented from an experimental investigation of microstrip coupled line filters and directional couplers.

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Application of the Point-Matching Method in Determining the Reflection and Transmission Coefficients in Linearly Tapered Waveguides (Correspondence)

T.D. Shockley, C.R. Haden and C.E. Lewis. "Application of the Point-Matching Method in Determining the Reflection and Transmission Coefficients in Linearly Tapered Waveguides (Correspondence)." 1968 Transactions on Microwave Theory and Techniques 16.8 (Aug. 1968 [T-MTT]): 562-564.

Several authors have presented papers concerning the application of both the point-matching method (collocation method) and the conformal-mapping method to the solution of eigenvalue problems for waveguides. In general, a solution by the conformal mapping method satisfies the boundary conditions in an exact sense while providing an approximate solution to the partial differential equation defining the problem. On the other hand, the point-matching method provides an exact solution to the partial differential equation, but satisfies the boundary conditions at a finite number of points. Ultimately the utilization of either method is determined by its applicability to a particular problem, while the accuracy of the theoretically predicted results can best be assessed in terms of a comparison with experimental data. The purpose of this correspondence is to illustrate the usefulness of the point-matching method in obtaining the E field transmission and reflection coefficients for a linearly tapered waveguide for the fundamental and higher order modes. Theoretically predicted results are then compared with existing experimental values to show the validity of the solutions.

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Avalanche Diode Application to Microwave Receivers (Correspondence)

E.T. Harkless. "Avalanche Diode Application to Microwave Receivers (Correspondence)." 1968 Transactions on Microwave Theory and Techniques 16.8 (Aug. 1968 [T-MTT]): 564-565.

Exploratory investigation into the application of germanium avalanche diodes as beat oscillators in microwave receivers has shown them to have some excellent characteristics for this use. The diodes used in this investigation were made by the Device Development Area of the Bell Telephone Laboratories. A minimum power output of 10 mW in the vicinity of 6 GHz was readily obtainable. Other characteristics of the oscillator such as noise and stability are controlled not only by the diode, but to a very great extent by the circuit in which the diode is imbedded.

Abstracts

First-Order Propagation in Moving Media (Correspondence)

D. Censor. "First-Order Propagation in Moving Media (Correspondence)." 1968 Transactions on Microwave Theory and Techniques 16.8 (Aug. 1968 [T-MTT]): 565-566.

In a recent paper, vector relations were established, leading to the wave equation in moving media. Essentially, we derived Tai's wave equation and three spatially independent vector solutions. Collier and Tai and Du and Compton discuss propagation in waveguides filled with axially moving media. Here we consider the first-order theory to get a relatively simple formalism, and discuss a few cases of interest.

Abstracts

The Exponential Horn as a Uniform Waveguide with a Variable Index of Refraction (Correspondence)

L.W. Zelby, A.J. Russo and S.G. Beard. "The Exponential Horn as a Uniform Waveguide with a Variable Index of Refraction (Correspondence)." 1968 Transactions on Microwave Theory and Techniques 16.8 (Aug. 1968 [T-MTT]): 566-567.

Plane-wave and transmission-line equations were applied to the interaction of a horn antenna with a stratified dissipative medium in its near field. The input impedances of an exponential horn terminated with a dissipative dielectric were calculated and measured at X-band frequencies.

Abstracts

Improvement to "Theory of Direct-Coupled-Cavity Filters" (Correspondence)

R. Levy and H.J. Riblet. "Improvement to "Theory of Direct-Coupled-Cavity Filters" (Correspondence)." 1968 Transactions on Microwave Theory and Techniques 16.8 (Aug. 1968 [T-MTT]): 567-568.

It is shown that improved agreement between theory and exactly computed results for direct-coupled-cavity filters may be obtained by a slight modification of the insertion-loss function presented in a previous paper.

Abstracts

Scattering Parameters of Binary Power Dividers (Correspondence)

H.J. Hindin. "Scattering Parameters of Binary Power Dividers (Correspondence)." 1968 Transactions on Microwave Theory and Techniques 16.8 (Aug. 1968 [T-MTT]): 568-569.

This correspondence determines, by means of the scattering matrix, the scattering parameters of the unisolated "binary" power divider at midband for a lossless structure. The input VSWR at all frequencies for this device has been analyzed and its advantages and disadvantages compared to the hybrid divider have been discussed. It is of interest to know the inherent output port isolation and VSWR's of the binary power divider without output isolation resistors, as this is an often-used device. A calculation of these quantities for the N-way power divider has been made by Kagen. With the continued use of "binary" structures in conventional TEM lines and its reintroduction into microstrip miniature and/or integrated circuits, it has been found necessary to make these calculations, which are also of theoretical interest.

Abstracts

Contributors (Aug. 1968 [T-MTT])

E. Bahar, J.J. Campbell, S.B. Cohn, M.E. Cram, D. Das, R.L. Fisher, W.R. Jones, D.T. Paris, O.P. Rustogi, C.C.H. Tang and E. Yamashita. "Contributors (Aug. 1968 [T-MTT])." 1968 Transactions on Microwave Theory and Techniques 16.8 (Aug. 1968 [T-MTT]): 570-571.

Abstracts

Information for Authors (Aug. 1968 [T-MTT])

"Information for Authors (Aug. 1968 [T-MTT])." 1968 Transactions on Microwave Theory and Techniques 16.8 (Aug. 1968 [T-MTT]): 572-572.

Abstracts

Table of Contents (Sep. 1968 [T-MTT])

"Table of Contents (Sep. 1968 [T-MTT])." 1968 Transactions on Microwave Theory and Techniques 16.9 (Sep. 1968 [T-MTT] (Special Issue on Noise)): 573-574.

Abstracts

Editorial Comment (Sep. 1968 [T-MTT])

S. Okwit. "Editorial Comment (Sep. 1968 [T-MTT])." 1968 Transactions on Microwave Theory and Techniques 16.9 (Sep. 1968 [T-MTT] (Special Issue on Noise)): 575-575.

The Topic of noise has always played a fundamental role in the field of microwaves and millimeters. In the past few years, many new contributions and worthwhile advances have been made in this field demanding the evolution of this issue. The size of this Transactions bears this out.

Abstracts

Introduction (Sep. 1968 [T-MTT])

W.W. Mumford. "Introduction (Sep. 1968 [T-MTT])." 1968 Transactions on Microwave Theory and Techniques 16.9 (Sep. 1968 [T-MTT] (Special Issue on Noise)): 576-577.

When I was invited by the regular editor, S. Okwit, to be Guest Editor of the special issue of this Transactions on the subject of noise, I had no idea how many man-hours of effort would be involved. My management may or may not have known either, but, nevertheless, they encouraged me to accept the invitation, which I did. I am happy to report that I have had their whole-hearted support not only in providing me with special secretarial assistance, communication conveniences, and incidental expenses, but also in granting me the time to complete the assignment.

Abstracts

Noise in Microwave Transistors

W. Baechtold and M.J.O. Strutt. "Noise in Microwave Transistors." 1968 Transactions on Microwave Theory and Techniques 16.9 (Sep. 1968 [T-MTT] (Special Issue on Noise)): 578-585.

Details of noise measurement techniques in the L- and S-bands are discussed. The complete noise parameters of microwave transistors are presented in the frequency range 0.6 to 4.2 GHz. Noise figure, available power gain, and noise measure are shown as a function of the source admittance and of the source reflection coefficient. The equivalent circuit and the noise figure of a microwave transistor are evaluated using an analog model.

Abstracts

Noise Considerations in Broad-Band Traveling-Wave Masers

J.A. De Gruyl, S. Okwit and J.G. Smith. "Noise Considerations in Broad-Band Traveling-Wave Masers." 1968 Transactions on Microwave Theory and Techniques 16.9 (Sep. 1968 [T-MTT] (Special Issue on Noise)): 586-595.

This paper examines in detail the noise performance of broad-band masers. A brief description is given on the longitudinal and transverse-staggering techniques of broad-banding. A review of the noise equations for a homogeneous maser is presented and a base for the development of a more general theory which takes into account bandwidth, passive loss, physical temperature, etc., for broad-band masers is given. Equations are developed and graphs presented which allow the evaluation of noise performance as a function of bandwidth. Comparisons of the two staggering techniques are given. Some experimental results are compared to theory and a critical analysis of the measurement technique for broad-band masers is included.

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The Ultra Cone: An Ultra-Low-Noise Space Communication Ground Radio-Frequency System

G.S. Levy, D.A. Bathker, W. Higa and C.T. Stelzried. "The Ultra Cone: An Ultra-Low-Noise Space Communication Ground Radio-Frequency System." 1968 Transactions on Microwave Theory and Techniques 16.9 (Sep. 1968 [T-MTT] (Special Issue on Noise)): 596-602.

Maximum sensitivity was required for the reception of Mariner V signals as it was occulted by the planet Venus. To meet this requirement, an ultra-low-noise radio-frequency system (ultra cone) was developed for the JPL/NASA Deep Space Instrumentation Facility (DSIF). The system consisted of an 85-foot antenna with a Cassegrain feed, low-noise transmission line components, and closed-cycle refrigerated maser amplifier. The antenna (at zenith), transmission line, and maser contributed about 9°K, 2°K, and 5°K, respectively, for a total operating noise temperature of approximately 16°K. The antenna feed, maser system, and calibration techniques are described in detail.

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The Simultaneous Measurement of Gain and Noise Using Only Noise Generators

J.M. Kenney. "The Simultaneous Measurement of Gain and Noise Using Only Noise Generators." 1968 Transactions on Microwave Theory and Techniques 16.9 (Sep. 1968 [T-MTT] (Special Issue on Noise)): 603-607.

The gain and noise of a linear two-port device can be measured simultaneously using two noise generators as the only signal sources. While this method is usable for measuring all linear two-port devices except those with high loss, it is particularly convenient for low-gain devices, for which it replaces three conventional measurements. The terms "minimum output temperature" and "standard output temperature" are introduced.

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Measurement of Cosmic Microwave Background Radiation

A.A. Penzias. "Measurement of Cosmic Microwave Background Radiation." 1968 Transactions on Microwave Theory and Techniques 16.9 (Sep. 1968 [T-MTT] (Special Issue on Noise)): 608-611.

The techniques associated with the measurement of antenna temperature at microwave frequencies are discussed. A number of experiments designed to measure cosmic microwave background radiation are described and their results compared. These results give a very good fit to a 3°K black body curve between 1.4 and 35 GHz.

Abstracts

Radiometric Measurement of Attenuation and Emission by the Earth's Atmosphere at Wavelengths from 4 cm to 8 mm

G.G. Haroules and W.E. Brown, III. "Radiometric Measurement of Attenuation and Emission by the Earth's Atmosphere at Wavelengths from 4 cm to 8 mm." 1968 Transactions on Microwave Theory and Techniques 16.9 (Sep. 1968 [T-MTT] (Special Issue on Noise)): 611-620.

Measurement instrumentation for the investigation of atmospheric noise fluctuations at 4 cm to 8 mm wavelengths is described. A brief review of the published literature on this subject is presented in support of the methods used in the measurement. Observations using the sun as a background source to obtain a measure of atmospheric opacity are described as providing an average value over an observing period frequently longer than the time during which a significant change in atmospheric opacity is detectable at these short wavelengths. Preliminary observational data are presented which indicate the potential of the measurement instrument to obtain the amplitude distribution function of sky noise fluctuations for various weather cases.

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Abstracts

Performance of a 3.3-mm Radiometer

W.A. Johnson. "Performance of a 3.3-mm Radiometer." 1968 Transactions on Microwave Theory and Techniques 16.9 (Sep. 1968 [T-MTT] (Special Issue on Noise)): 621-625.

The performance of a 3.3-mm radiometer, operational in the Space Radio Systems Facility of the Aerospace Corporation since December, 1963, is described, and a criterion for judging the long-integration-time performance of the radiometer is discussed. This criterion is applied to a study of radiometer output noise; from the results, it is inferred that the output noise spectral distribution is flat from a few ten-thousandths of a hertz to a few hertz.

Abstracts

A Radiometric Method for Measuring the Insertion Loss of Radome Materials

B.L. Seidel and C.T. Stelzried. "A Radiometric Method for Measuring the Insertion Loss of Radome Materials." 1968 Transactions on Microwave Theory and Techniques 16.9 (Sep. 1968 [T-MTT] (Special Issue on Noise)): 625-628.

Though radomes have been used for years as a means of protecting antennas from the elements, little appears in the literature to aid the engineer in his choice of the radome material to use in a particular installation. This may be due to the fact that many radome materials are adequate when used with a receiving system having a mixer (i.e., relatively hot) front end. However, an improper choice of radome material can seriously degrade a receiving system that employs a maser or other low-noise front end. A radiometric technique for the measurement of insertion loss is described, and a sample calculation, including error analysis, is presented.

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A Very Sensitive Airborne Microwave Radiometer Using Two Reference Temperatures

J.-P. Hach. "A Very Sensitive Airborne Microwave Radiometer Using Two Reference Temperatures." 1968 Transactions on Microwave Theory and Techniques 16.9 (Sep. 1968 [T-MTT] (Special Issue on Noise)): 629-636.

The accuracies of conventional microwave radiometers are influenced by instabilities mainly in their RF components A radiometer is described that uses two reference temperatnres. The signal processing eliminates the influences of all RF parameter changes on the radiometer indication. Thus the overall stability depends only on the reference temperatures and the low-frequency and dc components. These can be made extremely stable by careful design. The paper presents a detailed analysis of the radiometer performance. The minimum detectable signal is greater than that of a comparable Dicke radiometer, but approaches this, if the reference temperatures are appropriately chosen according to the particular measurement problem. The great advantage of the radiometer is that no measurement time is lost for frequent recalibration. Practical results of an X-band radiometer for airborne use are given at the end of the discussion. They are in good agreement with the theory and demonstrate the feasibility and superiority of the concept.

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A Method of Calibrating Coaxial Noise Sources in Terms of a Waveguide Standard

G.F. Engen. "A Method of Calibrating Coaxial Noise Sources in Terms of a Waveguide Standard." 1968 Transactions on Microwave Theory and Techniques 16.9 (Sep. 1968 [T-MTT] (Special Issue on Noise)): 636-639.

The UHF and microwave portion of the radio frequency spectrum is characterized by the use of several different types of transmission lines, the most common being coaxial line and rectangular waveguide. A frequent and recurring problem is that of calibrating an item which is fitted with one type of output (or input) terminals, in terms of a "standard" having a different set of terminals or connector. By an extension of certain techniques that were developed in an earlier paper on power calibration transfer, it is possible to make a similar comparison of noise sources. The procedure requires a suitable adaptor and a pair of measurements that are combined in such a way that the adaptor losses approximately cancel.

Abstracts

Measured Noise Temperature Versus Theoretical Electron Temperature for Gas Discharge Noise Sources

K.W. Olson. "Measured Noise Temperature Versus Theoretical Electron Temperature for Gas Discharge Noise Sources." 1968 Transactions on Microwave Theory and Techniques 16.9 (Sep. 1968 [T-MTT] (Special Issue on Noise)): 640-645.

In the past, measured noise temperatures T/sub n/ of a few commercially available gas discharge noise sources were indicated as agreeing with the predicted electron temperature T/sub e/ of the positive column based on the von Engel and Steenbeck relationship. Data were taken over the past 2 years on argon tubes over a pressure range of 5 to 40 mm and on neon tubes at 20 mm, with current variations from 100 to 300 mAdc. These data were compared against predicted electron temperatures. For the argon tubes at pressure-radius products greater than 20 mm/spl dot/cm there appeared to be reasonable correlation between the measured noise temperature and the predicted electron temperature although it is suggested that this correlation was fortuitous. For argon pressure-radius products less than 20 mm/spl dot/cm the measured noise temperature was as much as 15 percent lower than the predicted electron temperature. For neon tubes at 20-mm pressure, with the same variation in tube radius, and for pressure-radius products less than 24.0 mm/spl dot/cm, the measured noise temperature differed even more than for argon from the predicted electron temperature. A difference of as much as 30 percent at a pressure-radius product of 3.0 mm/spl dot/cm was observed. A qualitative explanation for argon is presented based mainly on the fact that these discharges do not have a Maxwellian distribution of electron velocities nor a velocity independent electron collision frequency. For neon the wide variation was not understood.

Click on title for a complete paper.

Abstracts

Microwave Thermal Noise Standards

C.T. Stelzried. "Microwave Thermal Noise Standards." 1968 Transactions on Microwave Theory and Techniques 16.9 (Sep. 1968 [T-MTT] (Special Issue on Noise)): 646-655.

Calibrated microwave thermal noise standards usually consist of a matched resistive element thermally isolated by a transmission line. They are used for microwave radiometry, antenna temperature calibrations, loss measurements, low-noise amplifier performance evaluation, and low-level CW signal level calibrations. The formula used to account for the distributed loss and temperature along the transmission line is derived and simplifying approximations and limitations are noted. Exact (hf/kT<<1) and approximate (hf/kT<<1, /spl pound/<<1) solutions for various loss and temperature distributions are tabulated. A FORTRAN computer program is available for a general solution that uses the transmission-line temperature and loss distributions for input data. The single largest source of calibration error is usually the microwave insertion loss measurements. The construction, calibration, and errors are discussed for a field-operational liquid-nitrogen-cooled waveguide noise standard. This standard is precisely calibrated and has a nominal noise temperature of (78.09 ± 0.12 peak)°K.

Abstracts

Plasma Noise Sources of Improved Accuracy

C.I. Denson and G.J. Halford. "Plasma Noise Sources of Improved Accuracy." 1968 Transactions on Microwave Theory and Techniques 16.9 (Sep. 1968 [T-MTT] (Special Issue on Noise)): 655-663.

Gas discharge tubes and waveguide mounts have been developed as reference standards of noise for S-, C-, and X-band in WR284, WR137, and WR90 waveguide. Their design and development are described and details of their performance are given. Particular attention has been paid to reducing the spread of noise output. At S- and X-band an overall absolute accuracy close to ±0.1 dB has been achieved for all possible combinations of tube and mount.

Abstracts

The Australian National Standards Laboratory X-Band Radiometer for the Calibration of Noise Sources

P.I. Somlo and D.L. Hollway. "The Australian National Standards Laboratory X-Band Radiometer for the Calibration of Noise Sources." 1968 Transactions on Microwave Theory and Techniques 16.9 (Sep. 1968 [T-MTT] (Special Issue on Noise)): 664-669.

The chief possible causes of error in the calibration of microwave noise sources are examined and a radiometer designed to minimize these errors is described. This includes a self-contained hot-load standard, facilities for measuring the hot-guide losses, a synchronously switched broad-band circulator, a switchable, high-stability attenuator, provision for measuring this attenuation, and a carbon-filament lamp reference noise source.

Abstracts

Measurement of the Noise Temperature of a Mismatched Noise Source

D.F. Wait and T. Nemoto. "Measurement of the Noise Temperature of a Mismatched Noise Source." 1968 Transactions on Microwave Theory and Techniques 16.9 (Sep. 1968 [T-MTT] (Special Issue on Noise)): 670-675.

A method is suggested that can measure the available power (or the effective temperature) of a noise generator independent of its reflection coefficient. A system utilizing a compensation generator and a tuned three-port circulator is constructed at X-band and evaluated for a noise generator of about 10,000°K. The error analysis and the experimental results indicate that the effective temperature of this generator, with a reflection coefficient of 0.5, can be measured within 0.6 percent in addition to the uncertainty of a standard needed to calibrate the system.

Abstracts

The Effect of Mismatched Components on Microwave Noise-Temperature Calibrations

T.Y. Otoshi. "The Effect of Mismatched Components on Microwave Noise-Temperature Calibrations." 1968 Transactions on Microwave Theory and Techniques 16.9 (Sep. 1968 [T-MTT] (Special Issue on Noise)): 675-686.

A technique is presented for analyzing the effect of mismatched components on the absolute noise-temperature calibrations of principal noise sources in a microwave receiving system. Scattering parameters are used to describe the properties of the microwave network that is connected between noise source and receiver. The calibration method discussed is the Y-factor power-ratio measurement technique involving the use of two thermal noise reference standards. Calculations made for an operational low-noise antenna receiving system indicate that, even when components have reasonably low-voltage reflection coefficients (typically less than 0.05), peak errors due to mismatches could be as high as 70 percent and 11 percent on measured antenna and effective input noise-temperature values, respectively. For the special case where the reflected and direct wave receiver noise sources are fully correlated, the peak errors can be even larger.

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Thermal Noise from a Passive Linear Multiport

D.F. Wait. "Thermal Noise from a Passive Linear Multiport." 1968 Transactions on Microwave Theory and Techniques 16.9 (Sep. 1968 [T-MTT] (Special Issue on Noise)): 687-691.

The thermal noise from passive multiports is discussed from fundamentals so that it can be understood, measured, or calculated by a microwave engineer. The multiports are assumed to have a uniform temperature, but with no restriction on reciprocity or mismatch. The noise temperature, T/sub N/, contributed by such a multiport is T/sub N/=A T where T is its physical temperature and A is its absorption coefficient. An approximate method of measuring A, and a method of measuring an A as small as 0.008 within 5 percent, are pointed out. Also, exact and approximate expressions for A in terms of scattering matrix elements and termination reflection coefficients are derived. Finally, the crosscorrelation of the noise from different ports is briefly considered.

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Matrix Representations of Noise Figures and Noise Figure Charts in Terms of Power Wave Variables

K. Hirano and S. Kanema. "Matrix Representations of Noise Figures and Noise Figure Charts in Terms of Power Wave Variables." 1968 Transactions on Microwave Theory and Techniques 16.9 (Sep. 1968 [T-MTT] (Special Issue on Noise)): 692-699.

The noise power, excess exchangeable noise figure, and excess transducer noise figure of a linear active two-port are represented by the power wave scattering transfer matrix. It follows that these noise figures are expressed as ratios of two Hermitian forms, and that their stationary values and the reflection coefficients at the input which yields them are obtained from the eigenvalues and the corresponding eigenvectors of each characteristic matrix. The excess transducer noise figure is considered here only for the case of the load being a resistor. It is proved that the transducer noise figure is equal to the exchangeable noise figure, which includes the contribution of equivalent noise at the input transformed through a two-port from the noise originating in the load. In order to evaluate graphically the change of noise figure of a two-port from its optimum value because of the reflection coefficient at the input, two kinds of noise figure charts are developed: one shows the contours of the constant noise figure normalized by the optimum value, and the other shows the contours of the constant difference between the prescribed noise figure and the optimum value. Their application to a practical problem is demonstrated. The noise figure of a linear active three-port with a passive termination /spl Zeta//sub 3/' at port 3 is expressed by a ratio of two Hermitian forms, and its stationary value and the reflection coefficient /spl Gamma/ /sub 3/ of /spl Zeta//sub 3/' which yields it are obtained. Two noise figure charts are presented by means of which the noise figure of a three-port for a specified /spl Gamma/ /sub 3/ can be evaluated.

Abstracts

Applications and Analysis of Noise Generation in N-Cascaded Mismatched Two-Port Networks

T. Mukaihata. "Applications and Analysis of Noise Generation in N-Cascaded Mismatched Two-Port Networks." 1968 Transactions on Microwave Theory and Techniques 16.9 (Sep. 1968 [T-MTT] (Special Issue on Noise)): 699-708.

Generalized equations are derived for noise generation and its propagation in linear N-cascaded two-port networks with mismatches. The analytical method is applied to microwave measurements in low-noise technology; e.g., in determining the effective input noise temperatures of a cryogenic paramp and the noise temperature of a cryogenic noise standard in a mismatched system. This approach is also applicable to mismatched networks at different temperatures. Two types of thermal noise standards utilizing liquid helium or helium gas as a refrigerant are described. Either type can be mounted on the back side of antennas and switched into the microwave-receiver line. However, the noise standard with the helium-gas refrigerator has the advantage of operating without refilling or spilling its coolant as the antenna elevation is varied.

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A Low-Temperature Microwave Noise Standard

C.L. Trembath, D.F. Wait, G.F. Engen and W.J. Foote. "A Low-Temperature Microwave Noise Standard." 1968 Transactions on Microwave Theory and Techniques 16.9 (Sep. 1968 [T-MTT] (Special Issue on Noise)): 709-714.

An X-band thermal noise source is described that consists of a waveguide termination, cooled in a cryogenic environment, along with temperature and pressure monitors and controls. With liquid helium as the cryogen, the effective noise output at the room temperature flange can be set to values around the boiling point of helium (4.2°K) with an accuracy of ± 0.05°K. With liquid nitrogen as the cryogen, the output temperature can be set to values around 77°K with an accuracy of ±0.13°K. This accuracy is made possible by several unique features. First, the terminating waveguide section is a vapor bulb thermometer with the absorbing load surrounded with the cryogenic liquid. Second, heat exchangers are used to permit an unusually short waveguide transition seetion between cryogenic and room temperature. Third, an absolute pressure regulator is used to control the cryogen boil-off rate resulting in a temperature stability of 0.003°K for helium and 0.02°K for nitrogen. At present, the useful accuracy of the standard is limited to ±0.1°K because of uncertainties in the insertion loss (about 0.001 dB) of mating room temperature flanges.

Abstracts

Radar Target Amplitude, Angle, and Doppler Scintillation from Analysis of the Echo Signal Propagating in Space

J.H. Dunn and D.D. Howard. "Radar Target Amplitude, Angle, and Doppler Scintillation from Analysis of the Echo Signal Propagating in Space." 1968 Transactions on Microwave Theory and Techniques 16.9 (Sep. 1968 [T-MTT] (Special Issue on Noise)): 715-728.

Radar target scintillation is observed in every type of radar system and has generally been analyzed on the basis of the performance of specific types of radar systems. However, the target scintillation phenomenon, including Doppler scintillation, may be expressed as distortions of the radar echo signal propagating in space, independent of radar system parameters. In this form it is convenient for visualizing the overall effects on radar systems and how these effects are altered by the radar system parameters. Past literature has demonstrated the target angle scintillation as a distortion of the radar echo signal phase front. Extension of this approach by a Poynting-vector analysis of the radar echo signal from a complex source shows a corresponding deviation of the direction of power flow consistent with the phase-front distortion theory and target scintillation measurements as well as describing all other target scintillation characteristics. The analysis demonstrates that deviations in the direction of the echo signal power flow from a complex target can be so large that the apparent source falls many target spans away from the actual target location. This is demonstrated by both tracking radar and single-beam search-type radar experiments. Although the theoretical angle deviations approach infinite error in target location, radar parameters, such as the finite size antenna aperture which perform a space integration of the echo signal, impose practical limitations. Typically, when a complex target such as an aircraft subtends an angle approaching a few tenths of a beamwidth, the antenna aperture integration will significantly limit the rms angle scintillation. Furthermore, the ways in which intentional means, such as diversity techniques, may be employed to reduce the effects of target scintillation on a radar are observed in Poynting-vector analysis. The analysis of the echo signal propagating in space provides a readily visualized basis for derivation of the Doppler scintillation caused by the airframe (rigid body portion) of a complex target which spreads the Doppler over a finite bandwidth when it has random yaw, pitch, and roll motion typical of aircraft in flight. The

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derivation relates the Doppler scintillation to the angle scintillation and the random motions typical of aircraft targets. A typical aircraft target with Gaussian-distributed angle scintillation and Gaussian-distributed rates of random motion will have a spike-shaped Doppler spectrum described by the modified Hankel function K/sub 0/ where the parameters are determined from the values of the rms angle scintillation and the rms angular rates of random motion. These values can be closely approximated without extensive measurements on the target. Experimental results verify the theory. The expressions used to derive the Doppler spectrum may be modified to accommodate non-Gaussian distributed angle scintillation and rates of angle motion.

Abstracts

Noise in the Presence of Strong Signals

B. Senitzky. "Noise in the Presence of Strong Signals." 1968 Transactions on Microwave Theory and Techniques 16.9 (Sep. 1968 [T-MTT] (Special Issue on Noise)): 728-732.

The electrical noise at millimeter wavelengths generated by an absorbing gas in a cavity is computed as a function of the intensity of an applied coherent signal. The phase of the noise components is strongly correlated with the phase of the coherent signal and the absorption and emission spectrum are similar in the neighborhood of the coherent signal frequency. As the intensity of the coherent field is reduced, the noise emitted by the gas-filled cavity becomes random and can be described by Nyquist's equation.

Abstracts

Noise in Mutually Synchronized Oscillators

W.O. Schlosser. "Noise in Mutually Synchronized Oscillators." 1968 Transactions on Microwave Theory and Techniques 16.9 (Sep. 1968 [T-MTT] (Special Issue on Noise)): 732-737.

The noise output of two mutually synchronized oscillators has been calculated. It is shown how the two oscillators contribute to the noise. The AM noise of the combined output signal turned out to be considerably increased compared to the AM noise of the free-running oscillators. The FM noise can be improved by proper choice of parameters. To check the theory measurements have been carried out which agree satisfactorily with the theoretical results.

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FM Noise Suppression of an Injection Phase-Locked Oscillator

M.E. Hines, J.-C.R. Collinet and J.G. Ondria. "FM Noise Suppression of an Injection Phase-Locked Oscillator." 1968 Transactions on Microwave Theory and Techniques 16.9 (Sep. 1968 [T-MTT] (Special Issue on Noise)): 738-742.

The phenomenon of injection phase-locking may be used to synchronize one or more oscillators to a lower power master or reference oscillator and also reduce part of the resultant FM noise power spectrum. A theory is presented that predicts the resultant FM noise spectrum of an injection phase-locked oscillator when the spectrum of the reference source and the free-running oscillator are known. Experiments conducted are described and comparison with theoretical predictions are discussed.

Abstracts

Microwave Oscillator Noise Reduction by a Transmission Stabilizing Cavity

J.R. Ashley and C.B. Searles. "Microwave Oscillator Noise Reduction by a Transmission Stabilizing Cavity." 1968 Transactions on Microwave Theory and Techniques 16.9 (Sep. 1968 [T-MTT] (Special Issue on Noise)): 743-748.

The theory of cavity stabilization of a microwave oscillator is reviewed and the appropriate design equations presented. The theory is verified with data taken on three different types of microwave oscillators: 1) a 10-GHz reflex klystron (stabilization factor achieved-22; FM noise reduction-28 dB; typical FM noise level-0.008 Hz in a 1-Hz bandwidth); 2) a 9.7-GHz low-noise two-cavity klystron oscillator (stabilization factor achieved-10; FM noise reduction--21.7 dB; typical FM noise level-0.0007 Hz in a 1-Hz bandwidth); 3) a 10-GHZ avalanche transit time diode oscillator (stabilization factor estimated at 30; FM noise reduction-29.5 dB; typical FM noise level--0.5 Hz in a 1-Hz bandwidth). Stabilization of the avalanche transit time diode oscillator produced a significant reduction in AM noise for modulation frequencies larger than the bandwidth of the stabilizing cavity.

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A Low-Noise Class-C Oscillator Using a Directional Coupler

H.J. Peppiatt, J.A. Hall and A.V. McDaniel, Jr.. "A Low-Noise Class-C Oscillator Using a Directional Coupler." 1968 Transactions on Microwave Theory and Techniques 16.9 (Sep. 1968 [T-MTT] (Special Issue on Noise)): 748-752.

An oscillator using a directional coupler is proposed as a solution to the design of efficient low-noise high-power high-frequency oscillators. FM noise measurements are presented for microwave sources derived via varactor multipliers from several different transistor oscillators of this type. The design has an isolated port which can be used to achieve injection phase lock. This feature is used to point out some of the interesting FM noise properties of these oscillators, the knowledge of which is important in the design and application of solid-state microwave sources. Also, experimental results are given which show how a low-noise microwave source can be built using a low-frequency crystal oscillator followed by a high-order varactor multiplier.

Abstracts

The Measurement of Oscillator Noise at Microwave Frequencies

J.R. Ashley, C.B. Searles and F.M. Palka. "The Measurement of Oscillator Noise at Microwave Frequencies." 1968 Transactions on Microwave Theory and Techniques 16.9 (Sep. 1968 [T-MTT] (Special Issue on Noise)): 753-760.

Improved measurement methods are presented for measuring both AM noise and FM noise from microwave oscillators, The Schottky barrier diode detector is used to measure AM noise 170 dB below the carrier in a 1 Hz bandwidth. A new discriminator is presented that has a measurement threshold below 0.001 Hz rms in a 1 Hz bandwidth. The use of a storage oscilloscope and wave analyzer to study noise modulation is discussed. The new discriminator and storage oscilloscope can be used for short-term stability measurements for intervals up to 100 seconds.

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The Measurement of Near-Carrier Noise in Microwave Amplifiers

K.H. Sann. "The Measurement of Near-Carrier Noise in Microwave Amplifiers." 1968 Transactions on Microwave Theory and Techniques 16.9 (Sep. 1968 [T-MTT] (Special Issue on Noise)): 761-766.

This paper discusses the measurement of additive noise in microwave power amplifiers, under CW and pulsed condition. The introduction of a pulsed carrier cancellation principle permits, for the first time, an investigation of the additive noise of pulsed amplifiers down to the thermal noise level. The measurement apparatus consists of three channels fed from a common source. One channel contains the amplifier under test. The other channel is pulsed by a "noise-free" modulator with the same pulse parameters as those of the test channel. The two signals are algebraically cancelled in a hybrid circuit and the difference signal, containing only the noise sideband of the amplifier, is coherently detected with the signal in the third channel. Measurements made on klystron amplifiers indicate that the level of the power spectral density of the FM noise approaches the thermal noise level, and that it has nearly the same value for CW and for pulsed operation.

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A Microwave System for Measurements of AM and FM Noise Spectra

J.G. Ondria. "A Microwave System for Measurements of AM and FM Noise Spectra." 1968 Transactions on Microwave Theory and Techniques 16.9 (Sep. 1968 [T-MTT] (Special Issue on Noise)): 767-781.

This paper describes a noise measuring system with a high degree of flexibility in regard to video frequency coverage as well as radio frequency coverage. Noise systems for S, X, and Ku-bands were constructed to obtain high sensitivity at spectral frequencies from several Hz to 30 MHz off the carrier. The measured limiting sensitivities of the X-band set over the video range 20 Hz to 325 kHz with an input power of 10 mW are --145 dB for AM noise and 0.02 Hz rms for FM noise in a 100-Hz measuring bandwidth.

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Investigations of the Noise Spectra of Avalanche Oscillators

E.F. Scherer. "Investigations of the Noise Spectra of Avalanche Oscillators." 1968 Transactions on Microwave Theory and Techniques 16.9 (Sep. 1968 [T-MTT] (Special Issue on Noise)): 781-788.

Measured amplitude noise spectra of X-band microwave oscillators rising silicon avalanche diodes are presented and compared with theoretical calculations. It was found that for the investigated diodes, the up-converted low-frequency noise (modulation noise) is the main contribution to the spectrum. In a frequency range extending from 1 kHz to several hundred MHz, the spectral noise power distribution is a sensitive function of the bias network impedance. Improvements in the noise-to-carrier power ratio of 5 to 15 dB were obtained by optimizing the bias network impedance. The dc current dependence of the amplitude noise spectrum is a complicated function of diode and circuit parameters. In general, the noise-to-signal ratio improves with increasing current. At high current densities, a reversal of this behavior may occor due to excess noise generation in the breakdown region and saturation effects of the signal power output. The equivalent rms deviation of the frequency modulation noise spectrum is typically one order of magnitude below that of the RF phase noise contribution due to RF noise sources, The phase noise spectrum of the oscillator is, therefore, not affected by the bias network impedance. Measurements on recent diodes indicate that the noise characteristics can be improved by careful control of the semiconductor device processing.

Abstracts

A Microwave Scanning Radiometer (Correspondence)

K. Kuenzi and E. Schanda. "A Microwave Scanning Radiometer (Correspondence)." 1968 Transactions on Microwave Theory and Techniques 16.9 (Sep. 1968 [T-MTT] (Special Issue on Noise)): 789-791.

A broad-band null-balancing scanning radiometer for 3-centimeter wave-length is described. Null-balance is achieved by using a diode in a feedback loop as a reference noise source. A radiometric map is instantaneously printed by an output writer during the antenna scan.

Abstracts

A Liquid Helium Cooled 4-GHz Broad-Band Parametric Amplifier (Correspondence)

J.G. Josenhans. "A Liquid Helium Cooled 4-GHz Broad-Band Parametric Amplifier (Correspondence)." 1968 Transactions on Microwave Theory and Techniques 16.9 (Sep. 1968 [T-MTT] (Special Issue on Noise)): 791-793.

This correspondence describes an experimented 4-GHz broad-band low-noise parametric amplifier (PA) that was operated at an ambient temperature of 4.2°K. The amplifier's noise performance is explained in order to predict what might be expected in the future.

Abstracts

Measurement of the Probability Density Function of a Microwave Noise Generator (Correspondence)

C. Bates and M. Ettenberg. "Measurement of the Probability Density Function of a Microwave Noise Generator (Correspondence)." 1968 Transactions on Microwave Theory and Techniques 16.9 (Sep. 1968 [T-MTT] (Special Issue on Noise)): 793-795.

A technique is described for measuring the probability density function (PDF) of a microwave noise generator. The noise output is sampled by a sampling oscilloscope and pulses corresponding to the sampled noise are analyzed by a pulse height analyzer. Standard statistical techniques are used to determine flatness and skewness of the PDF and to compare the measured PDF with that of the normal distribution.

Abstracts

On the Utility and Measurement of Voltage Probability Density of Wide-Band Microwave Noise (Correspondence)

A.H. Gottfried and J.J. Tancredi. "On the Utility and Measurement of Voltage Probability Density of Wide-Band Microwave Noise (Correspondence)." 1968 Transactions on Microwave Theory and Techniques 16.9 (Sep. 1968 [T-MTT] (Special Issue on Noise)): 795-797.

A method is described for measuring the probability density function (PDF) of wide-band microwave noise. A sampling technique is used to divide down the spectrum bandwidth of microwave noise from the order of several GHz to several kHz. It is shown that the divided-down spectrum noise has the same PDF as the original microwave noise. The former has a spectrum within the frequency range of available pulse height analyzers, so that the PDF can be measured with a pulse height analyzer in conjunction with a pulse counter.

Abstracts

Band Transition Noise Measurements of Gas Discharge Noise Sources (Correspondence)

K.W. Olson. "Band Transition Noise Measurements of Gas Discharge Noise Sources (Correspondence)." 1968 Transactions on Microwave Theory and Techniques 16.9 (Sep. 1968 [T-MTT] (Special Issue on Noise)): 797-797.

A method is described for establishing the excess noise ratio of a gas discharge noise source in a waveguide band for which a known output source is not available. The unknown waveguide bands are covered using "inter-band" or "cross-band" tubes. The method includes noise comparisons, hot insertion loss measurements, and corrections from tube-in-mount noise to tube-only noise in both bands. The errors are discussed.

Abstracts

AM/PM Noise Conversion in a Microwave Signal Source (Correspondence)

J.H. Thomas. "AM/PM Noise Conversion in a Microwave Signal Source (Correspondence)." 1968 Transactions on Microwave Theory and Techniques 16.9 (Sep. 1968 [T-MTT] (Special Issue on Noise)): 797-799.

The significance of AM/PM noise conversion on the prediction of noise performance in an FM microwave radio system is illustrated by means of a specific example. An expression is derived relating the baseband noise power contribution due to AM/PM conversion in terms of the PM baseband noise power contribution.

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Rutile Traveling-Wave Maser System for the Onsala 84-Foot Radio Telescope (Correspondence)

O.E.H. Rydbeck and E. Kollberg. "Rutile Traveling-Wave Maser System for the Onsala 84-Foot Radio Telescope (Correspondence)." 1968 Transactions on Microwave Theory and Techniques 16.9 (Sep. 1968 [T-MTT] (Special Issue on Noise)): 799-803.

This correspondence describes the practical application of a series of extremely compact high-gain traveling-wave masers for the frequency range 1300 to 3400 MHz, using chromium-doped rutile as active material. These masers, which are electronically tunable through bands of 200 MHz, or more, are characterized both by flexibility and mechanical rigidity. They are especially built for galactic and extragalactic microwave emission studies, for example anomalous 18-cm OH radiation, with the 84-foot equatorially mounted radio telescope at the Onsala Space Research Observatory, Sweden.

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J.R. Ashley, W. Baechtold, D.A. Bathker, W.E. Brown, J.-C.R. Collinet, J.A. De Gruyl, C. Denson, J.H. Dunn, G.F. Engen, W.J. Foote, J.-P. Hach, J. Halford, J.A. Hall, G.G. Haroules, W.H. Higa, M.E. Hines, K. Hirano, D.L. Hollway, D.D. Howard, W.A. Johnson, S. Kanema, J.M. Kenney, G.S. Levy, A.V. McDaniel, Jr., T. Mukaihata, T. Nemoto, S. Okwit, K.W. Olson, J.G. Ondria, T.Y. Otoshi, F.M. Palka, A.A. Penzias, H.J. Peppiatt, K.H. Sann, E.F. Scherer, W.O. Schlosser, C.B. Searles, B.L. Seidel, B. Senitzky, J.G. Smith, P.I. Somlo, C.T. Stelzried, M.J.O. Strutt, C.L. Trembath and D.F. Wait. "Contributors (Sep. 1968 [T-MTT])." 1968 Transactions on Microwave Theory and Techniques 16.9 (Sep. 1968 [T-MTT] (Special Issue on Noise)): 804-810.

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An Optical Waveguide with the Optimum Distribution of the Refractive Index with Reference to Waveform Distortion

S. Kawakami and J.-I. Nishizawa. "An Optical Waveguide with the Optimum Distribution of the Refractive Index with Reference to Waveform Distortion." 1968 Transactions on Microwave Theory and Techniques 16.10 (Oct. 1968 [T-MTT]): 814-818.

The group velocities of different modes are not the same when a usual type of optical waveguide is considered. The envelope of an optical pulse is therefore broadened while the optical pulse travels. In the case of a two-dimensional waveguide, it is found that the group velocity of each mode can be made the same if an appropriate distribution of the refractive index in the guide is realized. When a waveguide with such an optimum distribution is considered, the group velocity is also independent of frequencies if the medium is dispersion free. The property mentioned above is closely related to the fact that such a waveguide has an ideal focusing property. In the case of a cylindrical optical waveguide in which the refractive index depends only on the radius, such an optimum distribution does not exist. A method of calculating the mean velocity of an arbitrary ray in the guide is described on the basis of the WKB approximation to the wave equation.

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Circuit Properties of Microwave Dielectric Resonators

A. Karp, H.J. Shaw and D.K. Winslow. "Circuit Properties of Microwave Dielectric Resonators." 1968 Transactions on Microwave Theory and Techniques 16.10 (Oct. 1968 [T-MTT]): 818-828.

The purpose of this paper is to present experimental data on the circuit properties of dielectric resonators which do not have conducting boundaries. The resonators are constructed of single-crystal rutile and strontium titanate, which, as has been shown by several authors, can form resonators of miniature size and high unloaded Q. We consider the lowest-order H mode, give measured values of resonant freqnency (for rectangular parallelepipeds), mechanical frequency tuning, control of coupling to microwave circuits, and discuss the measurement of, and typical values of, external Q of resonators mounted in waveguides. We also consider periodic propagating circuits consisting of linear arrays of mutually coupled resonators.

Abstracts

Voltage Induction Method for Microwave Susceptibility Measurements

M. Toda. "Voltage Induction Method for Microwave Susceptibility Measurements." 1968 Transactions on Microwave Theory and Techniques 16.10 (Oct. 1968 [T-MTT]): 828-835.

A voltage induction method of microwave susceptibility measurement has been proposed. A signal from a one-turn coil wrapped directly on a magnetic sample is phase sensitively detected, and the real and imaginary parts of susceptibility as a function of magnetic field are directly indicated on an oscilloscope. Analysis shows this method to have a much higher sensitivity for small samples than the conventional cavity perturbation method. Also, this method is characterized by a higher stability, since the measurement is not for the perturbation of the resonant curve of high Q cavity, but for RF magnetic flux in a sample which is relatively stable for a frequency fluctuation of the signal source, independent of the sample volume. This method has been checked with good agreement against a perturbation method for a sample where both methods could be used. A YIG film, which is too small (4 mm by 4 mm by 0.3μ) to obtain any detectable perturbation of cavity parameters, was successfully measured by this method. The new method allows very rapid measurement combined with a very simple procedure for the relative measurement of susceptibility.

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Propagation in Ferrite-Filled Coaxial Transmission Lines

R.S. Mueller and F.J. Rosenbaum. "Propagation in Ferrite-Filled Coaxial Transmission Lines." 1968 Transactions on Microwave Theory and Techniques 16.10 (Oct. 1968 [T-MTT]): 835-842.

The dispersion relations (/spl omega/-/spl beta/diagrams) for propagation of the quasi-TEM mode and higher-order symmetric modes in longitudinally magnetized ferrite-filled coaxial waveguide are presented. The dispersion relations for ferrite-filled coaxial cavity resonators are analyzed and presented graphically. The performance and operation of an X-band tunable ferrite filter is evaluated in light of the /spl omega/-/spl beta/diagrams

Abstracts

Transient Electromagnetic Guided Wave Propagation in Moving Media

H. Berger and J.W.E. Griemsmann. "Transient Electromagnetic Guided Wave Propagation in Moving Media." 1968 Transactions on Microwave Theory and Techniques 16.10 (Oct. 1968 [T-MTT]): 842-849.

An analytical study of the influence of moving media on the propagation of transient electromagnetic modal waves in dispersive waveguides is presented. The response to impulsive excitation is determined in exact closed form and used to demonstrate that the nature of the pulse distortion differs in each of the three cases, 1) 0 < u < c /spl equiv/ (/spl epsi/μ)/sup -½/, 2) v = c, and 3) c < v < c/sub 0/ /spl equiv/ (/spl epsi//sub 0/μ/sub 0/)/sup -½ (v = speed of the medium). An expression is derived from which the pulse waveform generated by an input of arbitrary form can be readily determined when 0 < v < c if the transient response to a similar input is known for v = 0. An untabulated Laplace transform pair is derived and used to determine the unusual pulse distortion in case 3) which shows a markedly discontinuous change from the pulse distortion in case 2). The theory illuminates a singular circumstance in which the Lorentz transformation is consistent with the "speed of light" differing from one inertial reference frame to another.

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A New Procedure for Calculating Varactor Q from Impedance Versus Bias Measurements

E.W. Sard. "A New Procedure for Calculating Varactor Q from Impedance Versus Bias Measurements." 1968 Transactions on Microwave Theory and Techniques 16.10 (Oct. 1968 [T-MTT]): 849-860.

The reasons for preferring the impedance versus bias method of measuring varactor Q at high frequencies are pointed out. To circumvent the circuit loss problem, a rigorous procedure has been developed, based on the Weissfloch equivalent circuit of a lossy two-port network, for extracting the varactor junction Q. Parallel circuit loss is automatically corrected for, but correction for series loss requires substitution of a dummy shorted varactor. The procedure is described along with an actual example of its use at 64 GHz. Simulated examples are also worked out to illustrate the effect of the initial reactance in series with the varactor junction, and to demonstrate the numerical correctness of the procedure.

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Amplification at 258 GHz Using a Saturated Gas Resonance

H.J. Liebe. "Amplification at 258 GHz Using a Saturated Gas Resonance." 1968 Transactions on Microwave Theory and Techniques 16.10 (Oct. 1968 [T-MTT]): 860-865.

A 258-GHz reflection amplifier was built which consisted of a cylindrical cavity (3 mm diam., 7 mm length) filled with hydrogen cyanide gas at pressures up to 0.1 torr. When the molecular resonance of the J = 2-->3 rotational transition of H/sup 12/C/sup 15/N and the cavity resonance coincided, about 100 μW of the monochromatic pump-power were sufficient to saturate the two-level quantum system. The pumped gas furnished a nonlinear (power-sensitive) impedance which was used to amplify weak AM-sidebands. The signal was reflected with a maximum gain of 20 dB and a bandwidth of 0.5 MHz. The variation of the amplification with gas pressure, pump power, frequency, Q-values, and cavity tuning was measured and analyzed. The low unloaded Q-value of the TE(0, 1, 11) resonator, the limited pump power available at 258 GHz, and matching difficulties prevented attainment of the theoretical gain-bandwidth product of 37 MHz at room temperatures. A measurement performed at 200°K indicated a threefold increase of this gain-bandwidth product.

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Microwave Circuit Analysis Using the Equivalent Generator Concept

T. Nemoto and D.F. Wait. "Microwave Circuit Analysis Using the Equivalent Generator Concept." 1968 Transactions on Microwave Theory and Techniques 16.10 (Oct. 1968 [T-MTT]): 866-873.

To facilitate a scattering matrix analysis of complicated microwave circuit problems, an equivalent generator approach has been developed. The equivalent generator parameters are stated in terms of the parameters of the actual circuit elements. These statements are expressed in terms of special determinants which make the results easier to remember, and easier to use. Three different types of problems are solved to demonstrate the utility of the method; the response from generalized reflectometers, the properties of cascaded multiports in terms of its elements, and the properties of multiports whose number of available ports have been reduced.

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Measurement of Dielectric Constant and Loss Tangent in Materials Having Large Dielectric Constants (Correspondence)

J.B. Horton and G.A. Burdick. "Measurement of Dielectric Constant and Loss Tangent in Materials Having Large Dielectric Constants (Correspondence)." 1968 Transactions on Microwave Theory and Techniques 16.10 (Oct. 1968 [T-MTT]): 873-875.

The measurement of relative dielectric constant epsilon/sub r/' and loss tangent tan delta in ferroelectric materials at microwave frequencies is made difficult by the large dielectric constant and loss tangents exhibited by these materials. The subject technique, outlined originally by Montgomery and later used for lossy ferroelectric materials by Burdick et al., involves the use of the voltage transmission coefficient for a wave incident on a sample (dielectric slab) whose parallel faces are normal to the direction of propagation.

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Abstracts

Equivalent Circuit for Parallel Conductor Array (Correspondence)

R. Seviora. "Equivalent Circuit for Parallel Conductor Array (Correspondence)." 1968 Transactions on Microwave Theory and Techniques 16.10 (Oct. 1968 [T-MTT]): 875-877.

An equivalent circuit for a parallel conductor array is presented. The circuit, based on the capacitance matrix of the array, is composed of parallel-connected unit elements. The transmission-line cascade equivalents of the interdigital and comb-line structure are shown to be readily obtained by inspection.

Abstracts

A Waveguide Isolator Using InSb (Correspondence)

W.G. May and B.R. McLeod. "A Waveguide Isolator Using InSb (Correspondence)." 1968 Transactions on Microwave Theory and Techniques 16.10 (Oct. 1968 [T-MTT]): 877-878.

Solid-state plasmas have been used as the basis of waveguide isolators, using the tensor properties of the dielectric constant in the presence of a dc magnetic field to produce nonreciprocal behavior. In the device repofted by Toda, field displacement of the signal propagated through InSb at 75°K in the presence of a transverse dc magnetic field was used to achieve isolation. Another device used Faraday rotation in a waveguide filled with InSb under a longitudinal magnetic field to achieve good isolation. In this correspondence isolators in which InSb only partially fills a waveguide are discussed, and experimental data at 35.0 GHz is given. Isolator action is achieved because the signal is excluded from or absorbed by the InSb, depending on the direction of rotation of a circularly polarized signal with respect to a longitudinal magnetic field. Low forward loss is possible since the signal is not transmitted through the InSb. The device is similar to existing ferrite devices.

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Diagnostics of an Anisotropic Plasma with a Microwave Fabry-Perot Resonator (Correspondence)

R.J. Chaffin and J.B. Beyer. "Diagnostics of an Anisotropic Plasma with a Microwave Fabry-Perot Resonator (Correspondence)." 1968 Transactions on Microwave Theory and Techniques 16.10 (Oct. 1968 [T-MTT]): 878-879.

The diagnostics of isotropic plasmas with a microwave Fabry-Perot resonator (MFPR) has proven to be a very valuable technique. This correspondence discusses the diagnostics of anisotropic plasmas (plasmas in the presence of a large static magnetic field) with the MFPR.

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Abstracts

On the Use of Finite-Length Metal Septa for Suppression of Higher Order Modes (Correspondence)

J.P. Quine. "On the Use of Finite-Length Metal Septa for Suppression of Higher Order Modes (Correspondence)." 1968 Transactions on Microwave Theory and Techniques 16.10 (Oct. 1968 [T-MTT]): 879-880.

The use of bifurcating metal septa of finite length for the suppression of higher order modes in square waveguides was discussed in a recent paper. In particular, it was suggested that a periodic array of such septa can be employed to realize band-stop filters for the higher order modes, and that by this means one can obtain a structure in which only the desired TE/sub 01/ mode can propagate.

Abstracts

Broadband Matching of a Parametric Amplifier by Using Fano's Method (Correspondence)

V. Porra and P. Somervuo. "Broadband Matching of a Parametric Amplifier by Using Fano's Method (Correspondence)." 1968 Transactions on Microwave Theory and Techniques 16.10 (Oct. 1968 [T-MTT]): 880-882.

By using Fano's broadband matching theory for passive circuits a simple Chebyshev matching method has been developed for a parametric amplifier. The results are more general than those of Connors.

Abstracts

A High-Power Waveguide Tuner (Correspondence)

C.E. Muehe, Jr.. "A High-Power Waveguide Tuner (Correspondence)." 1968 Transactions on Microwave Theory and Techniques 16.10 (Oct. 1968 [T-MTT]): 882-883.

A high-power waveguide tuner is often needed to remove small mismatches in microwave systems, or to produce a purposely mismatched load for testing purposes. For instance, a tuner is usually inserted in a traveling-wave resonator used for high-power testing to remove small mismatches caused by imperfections in the resonator or the microwave component being tested. Any reflected wave in the resonator is particularly troublesome because it is amplified by the same mechanism which produces ring gain, and also appears as a large mismatch at the input coupler. The highest-power tuners used previously consisted of hybrids, either short-slot or magic-Tee, with movable shorts in two of the arms. In a well-built traveling-wave resonator, the tuner is usually the first source of breakdown trouble as the power is raised. Breakdown occurs in the movable shorts or in the hybrid at about a quarter of the power the waveguide will theoretically handle. The tuner shown in Fig. 1 was designed to remove this limitation.

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Abstracts

Extended /spl nabla/ Relations with Reference to EM Waves in Moving Simple Media (Correspondence)

A. Nathan and D. Censor. "Extended /spl nabla/ Relations with Reference to EM Waves in Moving Simple Media (Correspondence)." 1968 Transactions on Microwave Theory and Techniques 16.10 (Oct. 1968 [T-MTT]): 883-884.

In the treatment of electromagnetic wave propagation in moving refractive media there occur operators of the form /bar /spl nabla///spl equiv//bar Lambda/ · (/spl nabla/ + V) whose properties are particularly useful when /bar Lambda/ and V are constant, corresponding to uniform motion in simple media.

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Characteristic Impedance of Dielectric Supported Strip Transmission Line (Correspondence)

M.A. Earle and P. Benedek. "Characteristic Impedance of Dielectric Supported Strip Transmission Line (Correspondence)." 1968 Transactions on Microwave Theory and Techniques 16.10 (Oct. 1968 [T-MTT]): 884-885.

Graphical data are presented which show characteristic impedance Z/sub 0/, and velocity ratio v, as functions of dimensional ratios for a particular inhomogeneous shielded strip transmission line.

Abstracts

The Design of Stepped Transmission-Line Transformers (Correspondence)

G.N. French and E.H. Fooks. "The Design of Stepped Transmission-Line Transformers (Correspondence)." 1968 Transactions on Microwave Theory and Techniques 16.10 (Oct. 1968 [T-MTT]): 885-886.

The matching of a complex load impedance to the characteristic impedance of a transmission line has been considered by Hamid and Yunik, who presented a mathematical solution for the length and characteristic impedance of the matching transformer. A simplified solution of this matching problem is presented using a standard Smith chart.

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Abstracts

The Effect of Surface Impedance Variation on Surface Wave Propagation Along a Rod Waveguide (Correspondence)

G.N. Tsandoulas. "The Effect of Surface Impedance Variation on Surface Wave Propagation Along a Rod Waveguide (Correspondence)." 1968 Transactions on Microwave Theory and Techniques 16.10 (Oct. 1968 [T-MTT]): 886-888.

The radiation field due to a surface wave propagating along a rod waveguide having a surface impedance that varies linearly with distance along the direction of propagation is investigated. It is shown that for diameters greater than about one wavelength the radiation pattern is steerable, but for small diameter-to-wavelength ratios the taper has no effect on the pattern

Abstracts

Frequency Behavior of Post-Coupled TEM Comb-Line Resonators (Correspondence)

R.M. Kurzrok. "Frequency Behavior of Post-Coupled TEM Comb-Line Resonators (Correspondence)." 1968 Transactions on Microwave Theory and Techniques 16.10 (Oct. 1968 [T-MTT]): 888-889.

In prior published work, the use of a transverse coupling post between adjacent TEM comb-line resonators was presented. Such a post acts as an electric shield reducing the electric coupling which is in phase opposition with the magnetic coupling. In this correspondence, additional experimental data will be presented on post-coupled comb-line resonators. It will be shown that a properly positioned coupling post can result in some useful couplings that are quite insensitive to filter center frequency. Similar coupling behavior has been previously obtained with optimally located coupling apertures in partitions between adjacent resonators.

Abstracts

A Treatment for Boundary Singularities in Finite Difference Solutions of Laplace's Equation (Correspondence)

K.B. Whiting. "A Treatment for Boundary Singularities in Finite Difference Solutions of Laplace's Equation (Correspondence)." 1968 Transactions on Microwave Theory and Techniques 16.10 (Oct. 1968 [T-MTT]): 889-891.

Several recent papers have dealt with the derivation of TEM mode transmission-line parameters by finite difference methods using a digital computer. The accuracy of the solution obtained for Laplace's equation can be generally improved by mesh refinement to an extent limited by mesh and iteration errors. Mesh errors will be accentuated by the presence of singularities in the region under consideration. In the immediate neighborhood of a singularity, Taylor's theorem no longer applies, and therefore the finite difference approximation will be invalid. Important boundary singularities occur in practice at the reentrant corners on the inner conductor of a rectangular coaxial line and at the edges of the thin strip used in "triplate" transmission line and microstrip. Most of the existing techniques, used in hand calculations, are unsatisfactory for overcoming this difficulty and in general workers have either ignored the singularity or omitted the meshes bordering it.

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Improvement of Frequency Characteristics of Preselector Using a Hybrid Circuit (Correspondence)

S. Nishimura and T. Makimoto. "Improvement of Frequency Characteristics of Preselector Using a Hybrid Circuit (Correspondence)." 1968 Transactions on Microwave Theory and Techniques 16.10 (Oct. 1968 [T-MTT]): 891-893.

Yamamoto and Miyauchi have reported on a preselector which filters many frequency bands, separated by nearly equal frequency difference alternately into two groups. Their preselector is constructed of a matched magic tee to which are connected two short-circuited waveguide sections of appropriate lengths at two mutually decoupled ports. It is to be used as a preselector of a channel separation filter which separates many frequency bands into respective ports. The disadvantage of this preselector is that the frequency characteristics of the insertion loss and leakage are not satisfactorily flat near the center frequency of each band. This correspondence proposes a method by which the frequency characteristic is improved or flattened.

Abstracts

The Feasibility of Locating Waveguide Arcs by Sound Ranging (Correspondence)

A. Browne. "The Feasibility of Locating Waveguide Arcs by Sound Ranging (Correspondence)." 1968 Transactions on Microwave Theory and Techniques 16.10 (Oct. 1968 [T-MTT]): 894-894.

In a high-power microwave system (particularly a CW or long-pulse system), it often becomes necessary to protect the transmitter from the damaging effects of RF breakdown in the waveguide. The onset of RF breakdown may be detected by optical detectors or by an increase in the reflected RF signal. Fast switches can be arranged to turn off the transmitter in a time of the order of a microsecond. Under these conditions, it becomes difficult to determine the location of the breakdown. This correspondence describes an experiment to test the feasibility of locating the arc by measuring the time delay required for the sound from the arc to reach a microphone placed at some point in the waveguide.

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Broadband Matching of Resonant Circuits and Circulators (Correction)

E. Schwartz. "Broadband Matching of Resonant Circuits and Circulators (Correction)." 1968 Transactions on Microwave Theory and Techniques 16.10 (Oct. 1968 [T-MTT]): 894-895.

On page 158, right column, first line, "R/sub c/" should have read "R/sub s/."

Abstracts

Microwave Faraday Effect and Propagation in a Circular Solid-State Plasma Waveguide (Corrections)

H.J. Kuno and W.D. Hershberger. "Microwave Faraday Effect and Propagation in a Circular Solid-State Plasma Waveguide (Corrections)." 1968 Transactions on Microwave Theory and Techniques 16.10 (Oct. 1968 [T-MTT]): 895-895.

On page 663 it is stated, in reference to (14), that In general k/sub T/² is a complex quantity. It is also stated that, since the imaginary part of k/sub T/² is very small, the dissipation term that is due to the imaginary part of k/sub T/ is treated as a perturbation.

Abstracts

Wideband, High-Selectivity Diplexers Utilizing Digital-Elliptic Filters (Corrections)

R.J. Wenzel. "Wideband, High-Selectivity Diplexers Utilizing Digital-Elliptic Filters (Corrections)." 1968 Transactions on Microwave Theory and Techniques 16.10 (Oct. 1968 [T-MTT]): 895-895.

The author wishes to thank Dr. E.M.T. Jones of Technology for Communications International for pointing out a discrepancy between the minimum stopband attenuation values (A/sub s/ dB) listed in the element value tables and those obtained by direct analysis for high values of the selectivity parameter k. The minimum stopband attenuation values (A/sub s/ dB) have been recomputed and the correct values (to within 1 dB) are listed in Table I above.

Abstracts

Contributors (Oct. 1968 [T-MTT])

H. Berger, J.W.E. Griemsmann, A. Karp, S. Kawakami, H.J. Liebe, R.S. Mueller, T. Nemoto, J.-I. Nishizawa, F.J. Rosenbaum, E.W. Sard, H.J. Shaw, M. Toda, D.F. Wait and D.K. Winslow. "Contributors (Oct. 1968 [T-MTT])." 1968 Transactions on Microwave Theory and Techniques 16.10 (Oct. 1968 [T-MTT]): 896-897.

Abstracts

Information for Authors (Oct. 1968 [T-MTT])

"Information for Authors (Oct. 1968 [T-MTT])." 1968 Transactions on Microwave Theory and Techniques 16.10 (Oct. 1968 [T-MTT]): 898-898.

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Membership Application (Oct. 1968 [T-MTT])

"Membership Application (Oct. 1968 [T-MTT])." 1968 Transactions on Microwave Theory and Techniques 16.10 (Oct. 1968 [T-MTT]): 899-899.

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Theory of the Suppressed-Rotation Reciprocal Ferrite Phase Shifter

W.E. Hord, F.J. Rosenbaum and C.R. Boyd, Jr.. "Theory of the Suppressed-Rotation Reciprocal Ferrite Phase Shifter." 1968 Transactions on Microwave Theory and Techniques 16.11 (Nov. 1968 [T-MTT]): 902-910.

A theory for the Reggia-Spencer reciprocal ferrite phase shifter is presented which explains the characteristic behavior of this device in terms of a nonreciprocal coupling of cross-polarized waveguide modes. The dominant mode is a distorted TE/sub 10/-like mode similar to that of a dielectric slab-loaded waveguide. The cross-polarized mode is a hybrid mode which is below cutoff. If this mode propagates, Faraday rotation occurs. The boundary value problem for these modes, in a ferrite described by a scalar, frequency-dependent permeability, is solved and theoretical design data is presented. The frequency-dependence of phase shift and the onset of Faraday rotation is predicted and compares well with experimental results.

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Abstracts

A Broad-Band Hybrid Junction and Application to the Star Modulator

R.B. Mouw. "A Broad-Band Hybrid Junction and Application to the Star Modulator." 1968 Transactions on Microwave Theory and Techniques 16.11 (Nov. 1968 [T-MTT]): 911-918.

A class I hybrid junction, S/sub 13/= S/sub 23/; S/sub l4/= -S/sub 24/ is described consisting of two separate pairs of parallel transmission lines or transformers connected to conjugate ports 1 and 2 meeting at two central terminal pairs which are conjuate ports 3 and 4. An analysis is made in terms of the admittance and scattering parameters which reveals the "magic tee" matrix. Conjugate port isolation is infinite and equality of coupling is perfect in principle for all frequencies. The potentials at the central terminals of the hybrid junction are suitable for driving elements connected as a four-branch star. The four-diode star mixer/modulator is described and realizations in lumped elements, coaxial line, stripline, and waveguide are discussed. Data are reported for coaxial line models covering the frequency range of 1 to 8 GHz in octave bandwidths. Other applications are discussed.

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Higher-Order Modes in Dielectrically Loaded Rectangular Waveguides

F.E. Gardiol. "Higher-Order Modes in Dielectrically Loaded Rectangular Waveguides." 1968 Transactions on Microwave Theory and Techniques 16.11 (Nov. 1968 [T-MTT]): 919-924.

The problem of propagation in a waveguide containing E-plane slabs of dielectric was considered previously by several authors. However, their treatment was limited to the TE/sub mo/ modes. A more general and complete derivation of the dispersion equations for all the modes existing in these structures is presented here. It is shown, on the basis of theoretical and experimental results, that the frequency bandwidth is much smaller than the values previously obtained, considering only the TE/sub mo/ modes, for many cases of practical interest

Abstracts

Calculation of Characteristic Admittances and Coupling Coefficients for Strip Transmission Lines

D.W. Kammler. "Calculation of Characteristic Admittances and Coupling Coefficients for Strip Transmission Lines." 1968 Transactions on Microwave Theory and Techniques 16.11 (Nov. 1968 [T-MTT]): 925-937.

An integral equation technique is presented which may be used to efficiently compute the Maxwellian capacitance matrix, i.e., the coefficients of capacitance and inductance, for any system of zero-thickness strip conductors located parallel to and between two ground planes, The TEM characteristic admittances for various operating modes and the coupling coefficients can then be obtained from the elements of this matrix. A single computer program based upon this technique can be used to compute the capacitance matrix for any particular strip line configuration desired and would thus be especially valuable to the design engineer who would like to quickly obtain accurate design curves for a previously unstudied configuration of ship conductors. This procedure gives much more accurate results in but a fraction of the computer time required when the more common finite difference equation approach is used, and it avoids the necessity for a separate mathematical analysis for each new strip line configuration, as would be required when using a conformal mapping technique. Illustrative results are given for several different strip-line configurations.

Abstracts

The Microwave Reflective Properties of Water Surfaces--I: The Reflectivity of Smooth Water at 19.24 and 22.43 GHz as Measured with a Free-Wave Microwave Reflectometer

E.J. Thompson, R.W. Silberberg, K.W. Gray and W.N. Hardy. "The Microwave Reflective Properties of Water Surfaces--I: The Reflectivity of Smooth Water at 19.24 and 22.43 GHz as Measured with a Free-Wave Microwave Reflectometer." 1968 Transactions on Microwave Theory and Techniques 16.11 (Nov. 1968 [T-MTT]): 938-943.

The reflectivity of smooth water has been measured with a free-wave reflectometer at frequencies of 19.24 and 22.43 GHz and for temperatures between 0° and 40°C. Reproducibility of the data for water temperatures below 20°C is better than ± 0.15 percent and the absolute accuracy of the reflectometer is thought to be ± 0.5 percent. The results deviate significantly from the early reflectivity measurements of Saxton and Lane but agree to within experimental error with values calculated from the absorption cell measurements of Lane and Saxton.

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Abstracts

A High-Accuracy Microwave Phase Standard for Use in Primary Calibration Laboratories

A.V. James. "A High-Accuracy Microwave Phase Standard for Use in Primary Calibration Laboratories." 1968 Transactions on Microwave Theory and Techniques 16.11 (Nov. 1968 [T-MTT]): 944-949.

This paper describes the theory and construction of a broad-band, differential phase shifter for use over the frequency range of from 4.25 to 6.20 GHz. Perturbations of the phase shifter which cause it to deviate from the ideal 2/spl theta/ operation are discussed. The analysis follows that of Fox, but is carried out in the exponential form, and includes both phase and attenuation constants. A set of nonideal conditions are postulated: improper positioning and matching of the constituent components, improper electrical lengths of the differential phase shift sections, and loss in the dielectric slabs. Expressions are derived for each of the above conditions that demonstrate the effect on the 2/spl theta/ operation of the phase shifter. Evaluation of the experimental model shows that it operates within the predicted limits of error, ± 0.5°.

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Harmonic Generation Inside a Plasma Column at Resonance (Correspondence)

R.E. McIntosh. "Harmonic Generation Inside a Plasma Column at Resonance (Correspondence)." 1968 Transactions on Microwave Theory and Techniques 16.11 (Nov. 1968 [T-MTT]): 950-951.

Harmonic generation inside a plasma column at resonance is considered in this correspondence. Experiments were performed in which harmonics of an S-band signal were observed. It is of interest that enhancement of each harmonic occurs not only at the Tonks-Dattner resonances of the incident signal, but also at the resonances of the harmonic itself. Furthermore, the experiments demonstrate that at high incident power levels the relationship between the power in the exciting and harmonically generated waves is not simple at resonance.

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Parametric Amplification of Magnetoelastic Waves at Room Temperature (Correspondence)

D.E. Lacklison and M.F. Lewis. "Parametric Amplification of Magnetoelastic Waves at Room Temperature (Correspondence)." 1968 Transactions on Microwave Theory and Techniques 16.11 (Nov. 1968 [T-MTT]): 951-952.

Some experiments on parametric amplification of magnetoelastic waves in YIG rods are described. It is shown that the amplification obtained using a CW Pump is appreciably less than that obtained using a pulsed pump. The delays of the parametrically excited echoes are shown to be consistent with a particular pumping sequence.

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A Spark-Gap Switch for Oversize Rectangular Waveguides (Correspondence)

J.P. Quine, C. Younger, L. Tonks and E.H. Holt. "A Spark-Gap Switch for Oversize Rectangular Waveguides (Correspondence)." 1968 Transactions on Microwave Theory and Techniques 16.11 (Nov. 1968 [T-MTT]): 952-955.

A spark-gap switch is described for the TE/sub 10/ mode in oversize rectangular waveguides having both cross-sectional dimensions approximately two free-space wavelengths. A symmetrical array of eight dc-triggered spark gaps was employed to suppress all higher-order propagating modes except the TE/sub 30/ mode. Techniques for suppressing the TE/sub 30/ mode are also described.

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The Numerical Solution of Waveguide Problems by Fast Fourier Transforms (Correspondence)

C.T. Carson. "The Numerical Solution of Waveguide Problems by Fast Fourier Transforms (Correspondence)." 1968 Transactions on Microwave Theory and Techniques 16.11 (Nov. 1968 [T-MTT]): 955-958.

The classical method of boundary matching in conjunction with "fast Fourier transforms" permits many waveguide problems to be easily solved. The use of fast Fourier transforms in the analysis of waveguide problems is described. The method is illustrated by analyzing a section of waveguide containing two identical irises. The susceptances obtained for single inductive and capacitive irises and the magnetic and electric fields close to a single inductive iris are given.

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Latching Reciprocal Polarization-Insensitive Phase Shifter (Correspondence)

P.J. Meier. "Latching Reciprocal Polarization-Insensitive Phase Shifter (Correspondence)." 1968 Transactions on Microwave Theory and Techniques 16.11 (Nov. 1968 [T-MTT]): 958-959.

In the recent literature, a ferrite device has been described that provides reciprocal phase shift for any wave polarization. Such a device is extremely useful for multifunction array antennas. Unfortunately, however, this device requires an external solenoid to provide the control field and, therefore, consumes considerable "holding" power. Moreover, the solenoid inductance and eddy currents induced within the waveguide walls limit the switching speed that can be obtained. A new ferrite phase shifter is now described that is a latching device in addition to being reciprocal and polarization insensitive.

Abstracts

On the Classification of Electromagnetic Waves in Ferrite Rods (Correspondence)

F.W. Schott and T.F. Tao. "On the Classification of Electromagnetic Waves in Ferrite Rods (Correspondence)." 1968 Transactions on Microwave Theory and Techniques 16.11 (Nov. 1968 [T-MTT]): 959-961.

Numerous studies of electro-magnetic waves in longitudinally magnetized ferrite rods have been made by various workers, yet the interrelationship between these various investigations is often not revealed. The use in this correspondence of a classification scheme based on the character of the radial wave numbers in the ferrite has accomplished two results: first, it has revealed characteristics of the modal solutions which were not previously apparent, and second, it has allowed the various studies to be placed in perspective and has clarified their relationship to one another.

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Impedance Relations in a Diode Waveguide Mount (Correspondence)

B.B. van Iperen. "Impedance Relations in a Diode Waveguide Mount (Correspondence)." 1968 Transactions on Microwave Theory and Techniques 16.11 (Nov. 1968 [T-MTT]): 961-963.

An improved relation has been derived between the microwave impedance of a packaged solid-state diode in a waveguide mount and the impedances measured at the waveguide terminals. This is accomplished by taking into account the lowest noncircumferential radial-line transmission mode at the diode reference surface. A practical example shows that ignoring this mode may cause substantial errors in measuring the impedance of packaged diodes.

Abstracts

A New Principle for Automatic Compensation of Unwanted Signal Level Fluctuation in Measuring Setups Which Include a Microwave Generator and Detector (Correspondence)

J. Kalinski. "A New Principle for Automatic Compensation of Unwanted Signal Level Fluctuation in Measuring Setups Which Include a Microwave Generator and Detector (Correspondence)." 1968 Transactions on Microwave Theory and Techniques 16.11 (Nov. 1968 [T-MTT]): 963-965.

A new principle for automatic compensation of signal level fluctuation is described. When applied in measuring setups which include a microwave generator and detector, the method will provide effective reduction of unwanted output signal variation in the setup, caused, for example, by the fluctuation of generator output level and/or detector sensitivity and input impedance.

Abstracts

A Dispersionless Variable Microwave Delay Line (Correspondence)

H. van de Vaart. "A Dispersionless Variable Microwave Delay Line (Correspondence)." 1968 Transactions on Microwave Theory and Techniques 16.11 (Nov. 1968 [T-MTT]): 965-966.

Recently Auld and Strauss described a systematic procedure for synthesizing the internal magnetic field required to realize prescribed magnetoelastic delay characteristics. An internal field distribution was derived which would yield a delay independent of frequency over a certain bandwidth, but adjustable in a controlled manner by the strength of the applied magnetic field.

Abstracts

A UHF Bandpass Filter Using Orthogonally Coupled Resonators (Correspondence)

E.A. Mariani. "A UHF Bandpass Filter Using Orthogonally Coupled Resonators (Correspondence)." 1968 Transactions on Microwave Theory and Techniques 16.11 (Nov. 1968 [T-MTT]): 966-967.

A narrow bandpass filter utilizing orthogonally coupled, capacitively loaded TEM resonators is described in this correspondence. The two-resonator filter had a 16-MHz 3-dB bandwidth centered at 377 MHz, and exhibited an overall unloaded Q of 1400 within a 10-in^3 volume.

Abstracts

Propagation in a Longitudinally Magnetized Ferrite-Filled Square Waveguide (Correspondence)

W.E. Hord and F.J. Rosenbaum. "Propagation in a Longitudinally Magnetized Ferrite-Filled Square Waveguide (Correspondence)." 1968 Transactions on Microwave Theory and Techniques 16.11 (Nov. 1968 [T-MTT]): 967-969.

The normal modes of a ferrite-filled longitudinally magnetized square waveguide are found using the generalized telegraphist's equations. The solutions are right- and left-hand circularly polarized waves. The predicted differential phase shift is within 10 percent of the experimental result.

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Conductance Data for Offset Series Slots in Stripline (Correspondence)

R.W. Breithaupt. "Conductance Data for Offset Series Slots in Stripline (Correspondence)." 1968 Transactions on Microwave Theory and Techniques 16.11 (Nov. 1968 [T-MTT]): 969-970.

Frequency-independent curves are presented which can be used to calculate the conductance of offset series slots in stripline for 50-ohm characteristic impedance and three common ground plane spacings. Experimental verification is given for a particular case.

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Upper and Lower Bounds on the Characteristic Impedance of TEM-Mode Transmission Lines with Curved Boundaries (Correspondence)

D.H. Sinnott. "Upper and Lower Bounds on the Characteristic Impedance of TEM-Mode Transmission Lines with Curved Boundaries (Correspondence)." 1968 Transactions on Microwave Theory and Techniques 16.11 (Nov. 1968 [T-MTT]): 971-972.

Finite difference techniques for the treatment of two-dimensional potential problems are extended to include the case of zero normal-gradient specified on curved conductors. A solution for the conjugate potential problem for configurations involving curved boundaries is then possible. The application to TEM-mode problems permits upper and lower bounds to be calculated for characteristic impedance.

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Parallel-Strip Line Embedded in or Printed on a Dielectric Sheet (Correspondence)

E. Yamashita and S. Yamazaki. "Parallel-Strip Line Embedded in or Printed on a Dielectric Sheet (Correspondence)." 1968 Transactions on Microwave Theory and Techniques 16.11 (Nov. 1968 [T-MTT]): 972-973.

The characteristics of a parallel-strip line embedded in or printed on a dielectric sheet are formulated by using a variational method. Theoretical and experimental values of the line capacitance are compared in the case of aluminum-foil strips on a polystyrene sheet.

Abstracts

Extension to Nonresonant Perturbation Theory (Correspondence)

C.W. Steele. "Extension to Nonresonant Perturbation Theory (Correspondence)." 1968 Transactions on Microwave Theory and Techniques 16.11 (Nov. 1968 [T-MTT]): 973-974.

The nonresonant perturbation theory for the measurement of electric and magnetic RF fields is extended to the use of a null-type bridge. The signal at the detector port of the bridge is related to the electric and magnetic fields at the point of perturbation.

Abstracts

A Technique for Improving the Figure-of-Merit of a Twin-Slab Nonreciprocal Ferrite Phase Shifter (Correspondence)

W.P. Clark. "A Technique for Improving the Figure-of-Merit of a Twin-Slab Nonreciprocal Ferrite Phase Shifter (Correspondence)." 1968 Transactions on Microwave Theory and Techniques 16.11 (Nov. 1968 [T-MTT]): 974-975.

An RF phaser of considerable importance for phased-array applications is the twin-slab nonreciprocal ferrite phase shifter whose cross section is shown in Fig. 1. This device has been treated extensively in the literature and a number of techniques directed towards optimizing the figure-of-merit (phase shift/insertion loss) have been discussed. In general, these optimization techniques involve variations in the waveguide width W, the toroid branch width w, the toroid slot width s, and the dielectric constant of the slot-filling dielectric material. An additional technique that can be employed to obtain as much as a 20-percent increase in the figure-of-merit without degradation to other parameters of the device involves chamfering the corners of the toroid which results in a device whose cross section is shown in Fig. 2.

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The Characteristic Impedance of Waveguide (Correspondence)

L. Young. "The Characteristic Impedance of Waveguide (Correspondence)." 1968 Transactions on Microwave Theory and Techniques 16.11 (Nov. 1968 [T-MTT]): 975-976.

In a recent paper, Riblet has given a design procedure for multisection inhomogeneous impedance transformers. He gave the measured points for an experimental transformer, and this writer computed a curve for his example (Fig. 4 in footnote 1).

Abstracts

Discussion of Effect of Realizability Conditions upon Estimated Limits of Mismatch Error in the Calibration of Fixed Attenuators (Correspondence)

R.W. Beatty. "Discussion of Effect of Realizability Conditions upon Estimated Limits of Mismatch Error in the Calibration of Fixed Attenuators (Correspondence)." 1968 Transactions on Microwave Theory and Techniques 16.11 (Nov. 1968 [T-MTT]): 976-976.

The effect of the realizability conditions for passive 2-ports upon the estimation of mismatch error limits for attenuation measurements is discussed. Only the case of the insertion of fixed, symmetrical, reciprocal 2-ports is considered. It is shown that the effect of realizability conditions need be considered only for certain ranges of attenuation and VSWR. Most attenuators encountered in practice do not fall within these ranges so that the conventional method of estimating mismatch error limits is usually satisfactory.

Abstracts

Contributors (Nov. 1968 [T-MTT])

C.R. Boyd, Jr., F.E. Gardiol, K.W. Gray, W.N. Hardy, W.E. Hord, A.V. James, D.W. Kammler, R.B. Mouw, F.J. Rosenbaum, R.W. Silberberg and E.J. Thompson. "Contributors (Nov. 1968 [T-MTT])." 1968 Transactions on Microwave Theory and Techniques 16.11 (Nov. 1968 [T-MTT]): 977-978.

Abstracts

Microwave Abstracts (Nov. 1968 [T-MTT])

"Microwave Abstracts (Nov. 1968 [T-MTT])." 1968 Transactions on Microwave Theory and Techniques 16.11 (Nov. 1968 [T-MTT]): 979-983.

Based on technical merit and timeliness, microwave papers in journals published outside the United States have been selected and compiled below, generally with brief abstracts. Reprints of the papers maybe obtainable by writing directly to the author or to the source quoted.

Abstracts

Information for Authors (Nov. 1968 [T-MTT])

"Information for Authors (Nov. 1968 [T-MTT])." 1968 Transactions on Microwave Theory and Techniques 16.11 (Nov. 1968 [T-MTT]): 984-984.

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Editorial (Dec. 1968 [T-MTT])

S. Okwit. "Editorial (Dec. 1968 [T-MTT])." 1968 Transactions on Microwave Theory and Techniques 16.12 (Dec. 1968 [T-MTT]): 985-985.

Starting with the January, 1969, issue, Prof. G. Haddad will be the Editor of the IEEE Transactions on Microwave Theory and Techniques. Prof. Haddad's many contributions to this Transactions has made him well known to the MTT community. I am confident that under his leadership this Transactions will undoubtedly grow in quality as well as broaden its spectrum of interest in microwave technology.

Abstracts

International Microwave Symposium (Dec. 1968 [T-MTT])

"International Microwave Symposium (Dec. 1968 [T-MTT])." 1968 Transactions on Microwave Theory and Techniques 16.12 (Dec. 1968 [T-MTT]): 986-989.

The annual IEEE International Microwave Symposium was held in Detroit, Michigan, on May 20-22, 1968. This important meeting of our professional group serves as the basis of stimulating and disseminating new techniques in the microwave field. This year's meeting was the first to be held in the Midwest and was hosted by the Southeastern Michigan chapter of the professional group; the registered attendance was 493.

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Abstracts

Non-Minimum-Phase Microwave Filters (Dec. 1968 [T-MTT])

T.T. Fjallbrant. "Non-Minimum-Phase Microwave Filters (Dec. 1968 [T-MTT])." 1968 Transactions on Microwave Theory and Techniques 16.12 (Dec. 1968 [T-MTT]): 990-994.

Several restriction are normally imposed on the type of transfer functions which can be realized as practical microwave filters. Conventional waveguide filter structures cannot realize general nonminimum-phase functions with transmission zeros in the right half-plane. These networks are, however, of great importance as much better combinations of phase and amplitude characteristics can be achieved through the use of these filters. In this paper a new type of filter is analyzed, in which reactive elements are combined in a special way with a magic-T or a 90-degree microwave hybrid. A synthesis procedure is given for the realization of transfer functions with zeros in any or both halves of the complex frequency plane. This realization leads to canonic networks with ladder type structures. It is also shown how antireciprocal phase shifters can be used to realize modulators, or special types of filter functions.

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Abstracts

Analysis and Synthesis of Waveguide Multiaperture Directional Couplers (Dec. 1968 [T-MTT])

R. Levy. "Analysis and Synthesis of Waveguide Multiaperture Directional Couplers (Dec. 1968 [T-MTT])." 1968 Transactions on Microwave Theory and Techniques 16.12 (Dec. 1968 [T-MTT]): 995-1006.

A precise method of analysis of multiaperture waveguide directional couplers has been developed and used to investigate the performance of couplers designed both by conventional theories and by a new synthesis technique. The analysis is based on the equivalent four-port network of the coupler, the apertures being represented by lumped reactances in series and/or shunt with dispersive transmission lines, representing the waveguides. The effects of finite aperture dimensions and common wall thickness are taken into account. Many couplers designed on the usual basis of a first-order loose-coupling approximation have good directivity, even for tight (3 dB) coupling, but previous theories do not give the predicted directivity and are often far from optimum in design. A new synthesis technique based on the distributed low-pass prototype filter has been devised, and shown to give results close to the predicted performance. It has led to the construction of compact multiaperture directional couplers having directivity greater than 43 dB over complete waveguide operating bands.

Abstracts

An Accurate Finite-Difference Method for Higher Order Waveguide Modes

M.J. Beaubien and A. Wexler. "An Accurate Finite-Difference Method for Higher Order Waveguide Modes." 1968 Transactions on Microwave Theory and Techniques 16.12 (Dec. 1968 [T-MTT]): 1007-1017.

The study of new waveguide shapes requires an accurate knowledge of their higher order modes for bandwidth consideration, waveguide discontinuity analysis, and multimode launching and propagation studies. The finite-difference method solved by successive overrelaxation is a very accurate and general technique for dominant mode solution. The method makes minimum demand on computer store, the number of storage locations required being equal to the order of the matrix defining the system of linear equations used. Convergence criteria require that this matrix be positive semidefinite. For modes higher than the dominant, the method fails to converge as this condition is violated. Solution is obtained by redefining the problem such that the matrix is positive semidefinite for all modes. An algorithm is described which produces one row at a time of the new matrix, as required for successive overrelaxation, and thus reserves almost all computer store for the eigenvector. The eigenvector elements give field potentials at discrete points in the guide cross section. Iteration for higher order modes is successfully applied with all the computational benefits realized by previous finite-difference schemes for the dominant mode. Examples studied are the rectangular, circular, asymmetric ridge, and lunar guides. Results for higher order cutoff wave numbers are usually accurate to within 0.1 percent.

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Ultrahigh-Speed Diode Switch for 50 GHz Band Utilizing Avalanche Breakdown in Varactor Diodes (Dec. 1968 [T-MTT])

S. Sugimoto. "Ultrahigh-Speed Diode Switch for 50 GHz Band Utilizing Avalanche Breakdown in Varactor Diodes (Dec. 1968 [T-MTT])." 1968 Transactions on Microwave Theory and Techniques 16.12 (Dec. 1968 [T-MTT]): 1017-1021.

Ultrahigh-speed switches for the 50 GHz frequency range utilizing avalanche breakdown in varactor diodes have been developed as transmitter-modulators for millimeter-wave PCM communication systems. By switching the diode between forward conduction and avalanche breakdown, better performance was obtained than with standard switching conditions. A typical switch of transmission type with a silver-bonded Ge varactor, GSB3C for an input power of +17 dBm at 48 GHz, gave an insertion loss of 3.5 dB with a maximum attenuation of 31 dB. Some of the distinctive characteristics of diode switches utilizing avalanche break-down in varactor diodes are discussed.

Abstracts

Parameters of Microstrip Transmission Lines and of Coupled Pairs of Microstrip Lines

T.G. Bryant and J.A. Weiss. "Parameters of Microstrip Transmission Lines and of Coupled Pairs of Microstrip Lines." 1968 Transactions on Microwave Theory and Techniques 16.12 (Dec. 1968 [T-MTT]): 1021-1027.

A theoretical analysis is presented of microwave propagation on microstrip, with particular reference to the case of coupled pairs of microstrip lines. Data on this type of transmission line are needed for the design of directional couplers, filters, and other components in microwave integrated circuits. The inhomogeneous medium, consisting of the dielectric substrate and the vacuum above it, is treated in a rigorous manner through the use of a "dielectric Green's function" which expresses the discontinuity of the fields at the dielectric-vacuum interface. Results are presented in graphical form for substrate dielectric constants of 1, 9, and 16, and a range of values of width and spacing of the strips. Numerical tables for these and other cases are also available. The tables present capacitance, characteristic impedance, and velocity of propagation of the even and odd normal modes. The method lends itself to the treatment of other geometries which are of practical interest, such as "thick" strips, presence of an unsymmetrically located upper ground plane, etc.

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Propagation in Longitudinally Magnetized Ferrite-Loaded Waveguide (Dec. 1968 [T-MTT])

D.C. Buck. "Propagation in Longitudinally Magnetized Ferrite-Loaded Waveguide (Dec. 1968 [T-MTT])." 1968 Transactions on Microwave Theory and Techniques 16.12 (Dec. 1968 [T-MTT]): 1028-1033.

Longitudinally magnetized reciprocal ferrite phase shifters have shown anomalous behavior in that some devices show increasing phase shift with increasing applied field, while others show decreasing phase shift with increasing applied field. This anomaly has been investigated theoretically by using a ferrite-filled parallel plane guide model. It is shown that for electrically thin guides the phase shift decreases with applied magnetic field, whereas with increased thickness, the phase shift becomes an increasing function of the applied field. The microwave electric and magnetic fields were calculated for various applied field values and reduced guide thicknesses. This showed that there are two competing mechanisms which govern the type of phase shift. These can be termed μ-effective" and "Faraday rotation." The latter sets in when the guide is thick enough to support a cross-polarized electric field of the same order of magnitude as the incident electric field. Similar analysis of the quasi-TE/sub 1/ and TM/sub 1/ modes were made, showing similar behavior at higher frequencies for a given guide thickness. Experimented verification of the quasi-TM/sub 0/ mode was made by observing transmission resonances versus applied field of resonated sections of ferrite-loaded reduced height guide.

Abstracts

A 500 kW X-Band Air-Cooled Ferrite Latching Switch (Dec. 1968 [T-MTT])

R.A. Stern and J.P. Agrios. "A 500 kW X-Band Air-Cooled Ferrite Latching Switch (Dec. 1968 [T-MTT])." 1968 Transactions on Microwave Theory and Techniques 16.12 (Dec. 1968 [T-MTT]): 1034-1037.

The design of a high-power air-cooled microwave SPDT switch which is capable of operation at peak and average power levels of 500 kW and 666 watts, respectively, is described. The unit is of a differential phase shift circulator design employing 90° nonreciprocal phase shift elements which are forced air cooled. The phase shifter design employs dual ferrite toroids, "floating" in reduced height RG-51 waveguide. Two approaches are compared for heat sinking the phase shifter; namely the "H-beam" and the "I-beam" configurations. The results obtained indicate that the I-beam configuration is superior to the "H-beam" configuration. The switch exhibits an insertion loss of 0.6 dB maximum and isolation greater than 20 dB over a 100 MHz bandwidth centered at 9.375 GHz. The input VSWR of the switch over the frequency band is less than 1.28:1.

Abstracts

Low-Pass Quasi-Optical Filters for Oversized or Focused-Beam Waveguide Applications (Dec. 1968 [T-MTT])

G.L. Matthaei and D.A. Leedom. "Low-Pass Quasi-Optical Filters for Oversized or Focused-Beam Waveguide Applications (Dec. 1968 [T-MTT])." 1968 Transactions on Microwave Theory and Techniques 16.12 (Dec. 1968 [T-MTT]): 1038-1047.

A form of low-pass quasi-optical filter for millimeter-wave and possibly infrared applications is described which consists of thin layers of dielectric interspersed with arrays of thin metallic strips in a manner similar to an artificial dielectric. Equivalent circuits for filter half-sections of the type used were developed, and formulas and graphs are presented from which image parameters for such half-sections can be obtained. A design procedure is given from which multisection fiters of this type can be designed from low-pass lumped-element prototypes in order to give prescribed transmission characteristics. Some trial designs were worked out and fabricated for use in oversized waveguide, and their responses were computed in detail with a digital computer. Except for some higher order mode effects believed to be due to the standard-size to oversize waveguide tapers which were used, the measured responses were in good agreement with the theory. Stopband edge ratios between 3:1 and 4:1 are possible. Filter structures of this type are amenable to fabrication by techniques similar to those used in integrated circuit technology.

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Optical Surface Waves on Thin Films and Their Application to Integrated Data Processors

R. Shubert and J.H. Harris. "Optical Surface Waves on Thin Films and Their Application to Integrated Data Processors." 1968 Transactions on Microwave Theory and Techniques 16.12 (Dec. 1968 [T-MTT]): 1048-1054.

Abstract-Plane waveguide modes excited on thin dielectric films in the visible spectrum are described and photographs of the modes of the first six orders, taken at the exit edge of the film, are shown. Photographs are also presented of interference patterns between separately excited modes, Measurement techniques based on the mode properties are discussed and the application of thin film techniques to integrated optical data processors is proposed.

Abstracts

Gunn Oscillator as a Frequency Memory Device (Correspondence)

J. Magarshack. "Gunn Oscillator as a Frequency Memory Device (Correspondence)." 1968 Transactions on Microwave Theory and Techniques 16.12 (Dec. 1968 [T-MTT]): 1055-1057.

A new application using a Gunn oscillator is described, in which it is placed in a multimode X-band cavity with resonant frequencies spaced about 200 MHz apart. It is found that for a given bias there are several stable frequencies at which a sample can oscillate with little residual oscillation at other frequencies. If the oscillator is first synchronized to a pilot, and the pilot is switched to another of the stable frequencies, the Gunn oscillator follows and continues to oscillate at that frequency when the pilot is removed. The switching can sometimes be performed by sending pulses on the bias. A tentative explanation is given.

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Abstracts

S-Band Integrated Parametric Amplifier Having both Flat-Gain and Linear Phase Response (Correspondence)

H.C. Okean and H. Weingart. "S-Band Integrated Parametric Amplifier Having both Flat-Gain and Linear Phase Response (Correspondence)." 1968 Transactions on Microwave Theory and Techniques 16.12 (Dec. 1968 [T-MTT]): 1057-1059.

This correspondence describes the design of a simple integrated S-band parametric amplifier that combines very low-noise performance at room temperature with the realization of very broad-band flat-gain and linear phase response. This amplifier therefore satisfies a need for broad-band, low-noise microwave preamplification in high-resolution radar receivers and high-quality microwave communication systems. Previously, the achievement of such a high level of parametric amplifier performance generally required the use of the ultimate in high-quality varactors and of intricate and expensive varactor mounting structures, even when the remainder of the amplifier components were integrated. In this design, the integration of virtually all of the essential amplifier components with respect to design and fabrication, utilizing printed circuit techniques and eliminating all intercomponent connectors and superfluous transmission lines, make the realization of such precise amplifier performance possible in a potentially low-cost mass-reproducible structure, using only moderately high-quality varactors.

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Abstracts

Recent Advances in Microstrip Circulators (Correspondence)

V.E. Dunn and A.J. Domenico. "Recent Advances in Microstrip Circulators (Correspondence)." 1968 Transactions on Microwave Theory and Techniques 16.12 (Dec. 1968 [T-MTT]): 1060-1061.

The increasing interest in the use of microstrip on thin ceramic substrates for microwave integrated circuits has motivated the development of ferrite circulators compatible with this configuration. This correspondence describes several recent developments which reduce the size of microstrip circulators, and make them more easily incorporated with microwave integrated circuits.

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Abstracts

Performance of Ultra-Bandwidth YIG Pulse Compression Networks (Correspondence)

W.L. Bongianni, J. Burnsweig and J.H. Polson. "Performance of Ultra-Bandwidth YIG Pulse Compression Networks (Correspondence)." 1968 Transactions on Microwave Theory and Techniques 16.12 (Dec. 1968 [T-MTT]): 1061-1064.

The magnetoelastic mode in axially magnetized rods of YIG, as originally described by Strauss, has been shown to operate as a wide bandwidth dispersive delay device capable of pulse compression. A necessary feature of such a device is that the signal level of the RF feedthrough be below the sidelobes of the recompressed pulse. To isolate the RF input from the output, it is necessary to operate the line in a two-port configuration. The problem with this configuration is that a conflicting polarization requirement enters when the ports are at opposite ends of the rod, and this usually means unacceptably high insertion losses. Other workers have successfully attacked this problem, but the solution usually requires the addition of a separate component which tends to complicate the final design. The solution presented here is to achieve elliptical polarization through the use of reflections at the rod faces. This has meant that only the orientation of the face with respect to the axis or the orientation of the axis with respect to the magnetic field has been modified.

Abstracts

Losses in Microstrip (Correction)

R.A. Pucel, D.J. Masse and C.P. Hartwig. "Losses in Microstrip (Correction)." 1968 Transactions on Microwave Theory and Techniques 16.12 (Dec. 1968 [T-MTT]): 1064-1064.

Equations (12a) and (12b) should read...

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J.P. Agrios, M.J. Beaubien, T.G. Bryant, D.C. Buck, T.T. Fjallbrant, J.H. Harris, D.A. Leedom, R. Levy, G.L. Matthaei, R. Shubert, R.A. Stern, S. Sugimoto, J.A. Weiss and A. Wexler. "Contributors (Dec. 1968 [T-MTT])." 1968 Transactions on Microwave Theory and Techniques 16.12 (Dec. 1968 [T-MTT]): 1065-1066.

Abstracts

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"Front Cover (Jan. 1969 [T-MTT])." 1969 Transactions on Microwave Theory and Techniques 17.1 (Jan. 1969 [T-MTT]): f1-f2.

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Output Power and Loss Analysis of 2/sup n/ Injection-Locked Oscillators Combined Through an Ideal and Symmetric Hybrid Combiner

J.R. Nevarez and G.J. Herskowitz. "Output Power and Loss Analysis of 2/sup n/ Injection-Locked Oscillators Combined Through an Ideal and Symmetric Hybrid Combiner." 1969 Transactions on Microwave Theory and Techniques 17.1 (Jan. 1969 [T-MTT]): 2-10.

The scattering matrix for an ideal (2/sup n/+1) port combiner, formed by interconnecting (2/sup n/-1) magic-tee hybrids, is developed. This matrix is then used to describe a coherent power-summing technique for 2/sup n/ injection-locked oscillators for n=3. The losses that arise from combining oscillators with different injection-locking characteristics are evaluated by two methods: 1) expressions for the output power and loss of the combiner as functions of the input signals are obtained with amplitude and phase as parameters; 2) a semigraphical solution for the combined output and loss is obtained by means of a flow chart and computer-generated gain, loss, and phase characteristics of a single-hybrid junction. The amplitude and phase balance required between individual oscillators for efficient power addition is described, giving the engineer a quantitative measure of the multiple-oscillator design requirements.

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Guided Waves in Inhomogeneous Focusing Media Part I: Formulation, Solution for Quadratic Inhomogeneity

C.N. Kurtz and W. Streifer. "Guided Waves in Inhomogeneous Focusing Media Part I: Formulation, Solution for Quadratic Inhomogeneity." 1969 Transactions on Microwave Theory and Techniques 17.1 (Jan. 1969 [T-MTT]): 11-15.

This work is a theoretical study of waves in a circular-cylindrical radially inhomogeneous guiding medium. A vector theory based upon Maxwell's equatious is used to derive linear homogeneous fourth-order equations satisfied by the longitudinal electric and magnetic field components for a medium in which the permittivity decreases monotonically from the propagation axis. The percentage change of permittivity from the guide axis to some radius a is assumed small. For modes with propagation constants approximately equal to the wave number at guide center, all field components are shown to satisfy second-order differential equations. In particular, all transverse field components are proportional to a single scalar function. In a lossless system with no containing boundary, a new class of polynomial-Gaussian solutions describes the longitudinal fields for the case of a quadratically decreasing permittivity, while the transverse fields are Gaussian-Laguerre. Mode patterns, propagation constants, and orthogonality relations are given. It is shown analytically that the modes tend to TE or TM as the mode order increases. Moreover, the transverse fields become dominant at large wave numbers, and the fields become tightly bound to the guide axis as the wave number and/or inhomogeneity increases. Studies of more general permittivity variations and wall effects will be reported shortly.

Abstracts

Leaky Waveguide: TE/sup cir//sub 01/ Circular Waveguide with Periodic Array of Circular Apertures

K. Mikoshiba and M. Kamimura. "Leaky Waveguide: TE/sup cir//sub 01/ Circular Waveguide with Periodic Array of Circular Apertures." 1969 Transactions on Microwave Theory and Techniques 17.1 (Jan. 1969 [T-MTT]): 15-19.

This paper describes propagation characteristics of periodic leaky waveguides for helix waveguides and solid metal waveguides carrying a TE/sup cir//sub 01/ mode based primarily on experimental studies. For low-loss leaky waveguides, this type has not been considered feasible, because of the critical problem encountered in mode conversion-reconversion at the circular apertures. Additional loss due to the periodic array of the circular apertures and TE/sup cir//sub 01/ loss/frequency characteristics of the periodic leaky waveguide using helix waveguides and solid metal waveguides are measured by the shuffle-pulse method in the X-band. The periodic leaky waveguides using solid metal waveguides are seen to be acceptable for practical use as a low-loss leaky waveguide system, according to these measurements.

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The Use of Interpolation in Improving Finite Difference Solutions of TEM Mode Structures

D.H. Sinnott. "The Use of Interpolation in Improving Finite Difference Solutions of TEM Mode Structures." 1969 Transactions on Microwave Theory and Techniques 17.1 (Jan. 1969 [T-MTT]): 20-28.

A finite difference potential solution to a TEM mode transmission line cross section may be used to define a continuous potential function, leading to an upper bound for the capacitance. The accuracy of the capacitance calculation is shown to depend on the potential function fitted. A method is developed for interpolating a suitable potential function; in the cases considered, the use of this potential function gave capacitance solutions with an error approximately one-fifth that obtained using the usual methods.

Abstracts

Theory and Design of Transmission Line All-Pass Equalizers

E.G. Cristal. "Theory and Design of Transmission Line All-Pass Equalizers." 1969 Transactions on Microwave Theory and Techniques 17.1 (Jan. 1969 [T-MTT]): 28-38.

A general theory of transmission line all-pass equalizers operating in either TEM, TE, or TM modes is presented. Application of the theory to practical problems is straightforward, and circuit realizations of the equalizers are often simply related to easily computed design curves. Although the theory, strictly speaking, is for commensurate transmission line networks, it is not essential that the network being equalized, or in narrow-band cases the equalizer itself, be of commensurate length lines. Design formulas for narrow-band equalizers of up to two cavities are presented, and a method for extending the design to a greater number of cavities is described. The effect of equalizer dissipation loss is investigated and briefly described. Two example designs are presented.

Abstracts

On Two-Idler Parametric Amplifiers (Correspondence)

A.R. Kerr. "On Two-Idler Parametric Amplifiers (Correspondence)." 1969 Transactions on Microwave Theory and Techniques 17.1 (Jan. 1969 [T-MTT]): 39-40.

The bandwidth characteristics of two-idler parametric amplifiers are investigated, and an approximate equivalent circuit derived. It is shown that under certain conditions the input impedance Z/sub in/ is nearly constant and independent of pump amplitude over a relatively wide bandwidth. Computer analysis of particular one- and two-idler amplifiers has yielded comparable bandwidths and noise figures for a single-idler amplifier with a compensating resonator at its input, and a two-idler amplifier. Measured results are given for an experimental two-idler amplifier.

Abstracts

Transmission-Type Esaki-Diode Amplifier Using Dielectric Loaded Rectangular Waveguide (Correspondence)

S. Toyota and T. Makimoto. "Transmission-Type Esaki-Diode Amplifier Using Dielectric Loaded Rectangular Waveguide (Correspondence)." 1969 Transactions on Microwave Theory and Techniques 17.1 (Jan. 1969 [T-MTT]): 40-42.

Esaki diodes (tunnel diodes) have been widely used in microwave amplifiers. A number of papers have been published on Esaki-diode amplifiers constructed in stripline or coaxial line, In 1961, Pedinoff reported a transmission-type Esaki-diode amplifier using rectangular waveguide. For the antenna receiving application, the reflected power from the transmission-type Esaki-diode amplifier is radiated into space, and therefore it is used as a preamplifier of a receiver without connecting a circulator. In 1966, Yamashita et al. derived the equivalent circuit of the oscillator constructed with waveguide from the view point of Green's function, and Getsinger calculated the equivalent circuit from that given by Marcuvitz for the waveguide loaded with dielectric post. This correspondence proposes a new type of transmission-type Esaki-diode amplifier using rectangular waveguide and presents the results of the analysis and experiments on the laboratory amplifier. The conventional uniform waveguide mounted with an Esaki diode tends to be unstable and thus cannot be used as an amplifier. In order to prevent oscillation, the authors have proposed the utilization of cutoff waveguide connected at both sides with dielectric loaded waveguides. The equivalent circuit of the amplifier given by Getsinger is not applicable for our amplifier, because it has been obtained for the case of the uniform waveguide propagating TE/sub 10/ mode, in which an Esaki diode is mounted. In the derivation of the equivalent circuit described in this paper, the Esaki diode is regarded as a very thin dielectric post with negative conductance through which a filamentary current flows. The effect of the reflection of higher modes from the discontinuous surfaces (the interfaces between the cut-off waveguide and the dielectric loaded waveguides) near the post has been taken into account. The experimental results have been in fair agreement with the theory using this equivalent circuit.

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Synthesis of Equally Terminated Low-Pass Lumped and Distributed Filters of Even Order (Correspondence)

L.F. Lind. "Synthesis of Equally Terminated Low-Pass Lumped and Distributed Filters of Even Order (Correspondence)." 1969 Transactions on Microwave Theory and Techniques 17.1 (Jan. 1969 [T-MTT]): 43-45.

A Chebyshev-like polynomial of even order is described which, when used in low-pass filter design of even order, allows for the output to input resistance ratio of the filters to be speeifted independently of the passband ripple level. This is an improvement on the conventional theory, which requires that the resistance ratio be a function of the passband ripple level. In particular, the important case of equally terminated lumped and distributed low-pass filters is considered in detail, and tables of element values are given for a large number of practical design specifications.Fig. 1. Modified insertion loss specification.

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Synthesis of Asymmetrical Branch-Guide Directional Coupler-Impedance Transformers (Correspondence)

L.F. Lind. "Synthesis of Asymmetrical Branch-Guide Directional Coupler-Impedance Transformers (Correspondence)." 1969 Transactions on Microwave Theory and Techniques 17.1 (Jan. 1969 [T-MTT]): 45-48.

In a recent paper an exact synthesis procedure for the symmetrical branch-guide directional coupler was described. In this design it was assumed that all port terminating resistances were equal.

Abstracts

Experimental Investigation with an Iris Beam Waveguide (Correspondence)

J.W. Mink. "Experimental Investigation with an Iris Beam Waveguide (Correspondence)." 1969 Transactions on Microwave Theory and Techniques 17.1 (Jan. 1969 [T-MTT]): 48-49.

Iris beam waveguides appear attractive from the viewpoint of simplicity. However, their dimensions in wavelengths are so large that they warrant consideration only for infrared or optical frequencies provided the alignment requirement is not too stringent. Previous experiments by Christian and Goubau have shown that the measured diffraction loss of these guides is in good agreement with theoretical expectations. The measurements reported in this correspondence were made with the primary purpose of obtaining information on the effect of alignment of the irises, the width of the iris frames, and the curvature of the guide axis on the transmission loss.

Abstracts

Selecting Matched Diodes from a Diode Array for Monolithic Balanced Mixers (Correspondence)

W.H. Leighton, Jr. and A.G. Milnes. "Selecting Matched Diodes from a Diode Array for Monolithic Balanced Mixers (Correspondence)." 1969 Transactions on Microwave Theory and Techniques 17.1 (Jan. 1969 [T-MTT]): 49-51.

Suppression of local oscillator noise in balanced mixers depends upon the degree of match of the mixer diode characteristics. A method of obtaining matched diodes in a monlithic mixer by fabricating an array of diodes and selecting a matched pair is proposed.

Abstracts

On the Accuracy Obtained when Using Variational Techniques for Asymetrically Loaded Waveguides (Correspondence)

A.V. Vorst and R. Govaerts. "On the Accuracy Obtained when Using Variational Techniques for Asymetrically Loaded Waveguides (Correspondence)." 1969 Transactions on Microwave Theory and Techniques 17.1 (Jan. 1969 [T-MTT]): 51-52.

The accuracy obtained by using an approximate procedure based on a variational principle is investigated in the case of a dielectric slab placed on the sidewall of a rectangular waveguide. It is shown that the error is much larger than the one obtained for a central loading, because of the coupling between even- and odd-order modes. The accuracy is a function of the compatibility between the field distribution for each mode taken in the expansion and the geometry of the loaded guide.

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Abstracts

An Improved Pulse-Forming Network for the Generation of Phase-Coherent Microwave Signals (Correspondence)

G.F. Ross. "An Improved Pulse-Forming Network for the Generation of Phase-Coherent Microwave Signals (Correspondence)." 1969 Transactions on Microwave Theory and Techniques 17.1 (Jan. 1969 [T-MTT]): 52-54.

Some practical aspects of designing TEM mode networks used to produce phase-coherent pulse-modulated microwave signals through the S-band portion of the spectrum are described. In particular, design data are presented for the construction of stub junctions in a series feed network.

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Abstracts

Synthesis of Particular Unit Real Functions of Reflection Coefficient (Jan. 1969 [T-MTT])

C.S. Gledhill and A.M.H. Issa. "Synthesis of Particular Unit Real Functions of Reflection Coefficient (Jan. 1969 [T-MTT])." 1969 Transactions on Microwave Theory and Techniques 17.1 (Jan. 1969 [T-MTT]): 54-55.

It has been shown that for a given function rho(z)... to be capable of physical realization as a cascade of uniform lossless transmission lines terminated by a resistor, the following conditions must be satisfied.

Abstracts

Wave Propagation in a Rectangular Waveguide Loaded with an H-Plane Dielectric Slab (Correspondence)

F.E. Gardiol and A.S. Vander Vorst. "Wave Propagation in a Rectangular Waveguide Loaded with an H-Plane Dielectric Slab (Correspondence)." 1969 Transactions on Microwave Theory and Techniques 17.1 (Jan. 1969 [T-MTT]): 56-57.

An exact solution is presented for the propagation and bandwidth characteristics of a rectangular waveguide containing an H-plane slab of lossless dielectric.

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E.G. Cristal, G.J. Herskowitz, M. Kamimura, C.N. Kurtz, K. Mikoshiba, J.R. Nevarez, D.H. Sinnott and W. Streifer. "Contributors (Jan. 1969 [T-MTT])." 1969 Transactions on Microwave Theory and Techniques 17.1 (Jan. 1969 [T-MTT]): 57-58.

Abstracts

Voluntary Page Charges (Announcement) (Jan. 1969 [T-MTT])

"Voluntary Page Charges (Announcement) (Jan. 1969 [T-MTT])." 1969 Transactions on Microwave Theory and Techniques 17.1 (Jan. 1969 [T-MTT]): 59-59.

Abstracts

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"Information for Authors (Jan. 1969 [T-MTT])." 1969 Transactions on Microwave Theory and Techniques 17.1 (Jan. 1969 [T-MTT]): 60-60.

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Abstracts

A Tunable Absorbing Band-Stop Filter: The Field Rotation Filter

P. Bernardi. "A Tunable Absorbing Band-Stop Filter: The Field Rotation Filter." 1969 Transactions on Microwave Theory and Techniques 17.2 (Feb. 1969 [T-MTT]): 62-66.

A study has been made of the propagation of the first-order modes in a structure obtained by placing a thin magnetized ferrite slab against a broad wall of a rectangular waveguide. The numerical solution of the characteristic equation shows that, with a suitable choice of parameters, it is possible to realize an electrically tunable band-stop filter. An experimental investigation carried out on a component constructed in this way has given results in full agreement with the theoretical analysis and has allowed an estimate to be made of the influence of the parameters on the selectivity characteristics and tunability of the filter.

Abstracts

Helix Leaky Waveguide

K. Mikoshiba and S. Nishida. "Helix Leaky Waveguide." 1969 Transactions on Microwave Theory and Techniques 17.2 (Feb. 1969 [T-MTT]): 66-73.

The propagation characteristics of leaky waves in a helix waveguide covered with a slitted cylinder are presented by a method of transverse network representation. The main interest is in helix waveguides with small pitch angles, characterized by a hybrid mode consisting of TE/sub 01/, and a small amount of TM/sub 01/ modes. The leaky wave discussed in this paper may then be regarded as a perturbation of the TM/sub 01/ wave by the slitted cylinder outside the helix. The radiation, metal, and dielectric losses are calculated numerically at a frequency of 50 GHz. The relation between the radiation loss and aperture angle of slit is very different from that of an ordinary leaky waveguide composed of a slitted cylinder without helix, especially when the distance between the helix and shield cylinder is about a quarter of the radial wavelength. The metal and dielectric losses are the same order as radiation loss, however the dielectric loss decreases as the power factor /spl epsiv/"/ /spl epsiv/' increases. The measured total attenuation constant averages about 5 dB/km, almost twice the theoretical value.

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Ray Optics-A Novel Approach to Scattering by Discontinuities in a Waveguide

H.Y. Yee and L.B. Felsen. "Ray Optics-A Novel Approach to Scattering by Discontinuities in a Waveguide." 1969 Transactions on Microwave Theory and Techniques 17.2 (Feb. 1969 [T-MTT]): 73-85.

Waveguide discontinuities are analyzed conventionally by techniques utilizing the induced field in the vicinity of the discontinuity for calculation of the distant reflected and transmitted field in the various modes. Evaluation of the induced field constitutes the major difficulty in the problem. By an alternative and novel approach explored in this paper, scattering by a discontinuity in a waveguide is deduced from a knowledge of its far zone (asymptotic) scattering properties in free space. In contrast to "small obstacle" techniques wherein similar concepts are utilized for isolated scatterers whose size is small compared to the free-space wavelength, the present procedure accommodates also large discontinuities such as strips, apertures, bifurcations, changes in cross section, etc. The description of various scattering processes is carried out naturally in terms of ray optics which provides at each stage of the calculation an interpretation of the associated physical mechanism. The procedure is illustrated for apertures, strips, and bifurcations in a parallel plane waveguide for which comparisons with exact solutions can be made. It is found that while the ray-optical technique is best suited to the high-frequency (multimode) regime far from modal cutoffs, it is capable of providing remarkable accuracy even in the range of propagation of only the dominant mode.

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Abstracts

Discontinuity Capacitance of a Coaxial Line Terminated in a Circular Waveguide

E.W. Risley, Jr.. "Discontinuity Capacitance of a Coaxial Line Terminated in a Circular Waveguide." 1969 Transactions on Microwave Theory and Techniques 17.2 (Feb. 1969 [T-MTT]): 86-92.

This calculation evaluates the discontinuity capacitance of a coaxial line terminated in a circular waveguide using the Rayleigh-Ritz variational technique. A 50-ohm 3/4-inch coaxial line termination with solid center conductor was fabricated with center and outer conductor dimensions of 0.32568± 0.00002 and 0.74995± 0.00002 inches, respectively. The measured value of capacitance of this termination at 1000 Hz was 2.164 x 10/sup -13/ farads as compared with the calculated value of 2.177093 x 10/sup -13/ farads. Calculated values of capacitance for other line sizes were also compared with measured values and in each case the calculated value agreed with the measured value to within the experimental error of the measured value.

Abstracts

Electromagnetic Wave Propagation Along a Ferrite Loaded Wire

R.S. Mueller and F.J. Rosenbaum. "Electromagnetic Wave Propagation Along a Ferrite Loaded Wire." 1969 Transactions on Microwave Theory and Techniques 17.2 (Feb. 1969 [T-MTT]): 92-100.

The dispersion relation for axially symmetric modes propagating on a surface waveguide composed of a central conductor surrounded by an axially magnetized ferrite tube has been obtained. Tuning curves for an open boundary post resonator are calculated and compared with experimental results for an X-band tunable filter. The modes of circulation of a three-port waveguide circulator utilizing this geometry have also been studied and experimentally verified.

Abstracts

Impedance Characteristics of a Class of Multiconductor Transmission Lines

J.J. Campbell and W.R. Jones. "Impedance Characteristics of a Class of Multiconductor Transmission Lines." 1969 Transactions on Microwave Theory and Techniques 17.2 (Feb. 1969 [T-MTT]): 101-107.

The characteristics of TEM modes propagating along a conical transmission line consisting of equiangular strips and exhibiting N-fold symmetry are investigated. Impedance eigenvalues for the eigenmodes of such structures are evaluated using no integral equation approach. Two techniques of calculating the eigenvalues are investigated and compared for this class of transmission line. The results are also compared to exact results available for self-complementary structures. Transverse field distributions along the conical line are also presented for the case N=6.

Abstracts

An Application of the Parametron Amplifier to the X-Band ESR Spectrometer

I. Takao and T. Hayashi. "An Application of the Parametron Amplifier to the X-Band ESR Spectrometer." 1969 Transactions on Microwave Theory and Techniques 17.2 (Feb. 1969 [T-MTT]): 107-113.

An application of the parametron preamplifier (the phasecoherent degenerate parametric amplifier) to the X-band superheterodyne ESR (electron spin resonance) spectrometer to improve its sensitivity is described. The sensitivity and obtainable signal-to-noise ratio of the parametron ESR spectrometer are analyzed theoretically and the results confirmed experimentally. The improvement at the low bridge input power level up to 0.2 mW was about 6 dB which corresponds to the improvement of noise figure obtainable because of the inherent low-noise characteristics of the parametron amplifier. However, the improvement at power level of 20 mW amounted to 20 dB which is ascribed to the phase-sensitive amplification characteristics of the parametron preamplifier that reject the out-of-phase FM noise.

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The Point-Matching Solution of Uniform Nonsymmetric Waveguides (Correspondence)

J.A. Fuller and N.F. Audeh. "The Point-Matching Solution of Uniform Nonsymmetric Waveguides (Correspondence)." 1969 Transactions on Microwave Theory and Techniques 17.2 (Feb. 1969 [T-MTT]): 114-115.

The point-matching method is a useful approximate procedure for solving uniform waveguide problems, and several unusual waveguides have been successfully investigated with this method. Recently, it was suggested that the method is valid only "when certain symmetries are maintained." It will be demonstrated that, although cross-sectional symmetry may sometimes increase the computational accuracy, it is certainly not a necessary requirement for an application of the method. Also, a simple method for examining the computational accuracy of point-matching solutions will be discussed.

Abstracts

Tailored Response Microwave Filter (Correspondence)

D.R. Wehner. "Tailored Response Microwave Filter (Correspondence)." 1969 Transactions on Microwave Theory and Techniques 17.2 (Feb. 1969 [T-MTT]): 115-116.

Conventional microwave bandpass, low-pass, and high-pass filters with resonant elements can be used to provide a variety of frequency responses, some of which may be useful as microwave amplitude equalization or weighting filters. Adequate fitting to special requirements, however, is often impossible. In addition, matching problems exist due to the nature of these filters to attenuate by reflection of the input signal.

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A Tapered Waveguide-to-Waveguide Adapter (Correspondence)

M. Bramanti and M. Calamia. "A Tapered Waveguide-to-Waveguide Adapter (Correspondence)." 1969 Transactions on Microwave Theory and Techniques 17.2 (Feb. 1969 [T-MTT]): 116-118.

This correspondence describes an adapter between two waveguides of different cutoff frequencies and very different sizes, the smaller waveguide being filled with dielectric material. Such an adapter has been realized for use in pulse-compression systems employing loaded waveguides.

Abstracts

A Proposed Microwave Structure and Design Method for the Traveling-Wave Modulation of Light (Correspondence)

E. Yamashita and K. Atsuki. "A Proposed Microwave Structure and Design Method for the Traveling-Wave Modulation of Light (Correspondence)." 1969 Transactions on Microwave Theory and Techniques 17.2 (Feb. 1969 [T-MTT]): 118-119.

A shielded three-medium strip line is proposed for the traveling-wave microwave modulation of light. The microwave velocity of this structure is evaluated based on a variational formula. Numerical values are presented for the case of a line comprising layers of carbon disulfide, glass, and air.

Abstracts

The Effect of Neutron Radiation on an IMPATT Diode (Correspondence)

R.J. Chaffin. "The Effect of Neutron Radiation on an IMPATT Diode (Correspondence)." 1969 Transactions on Microwave Theory and Techniques 17.2 (Feb. 1969 [T-MTT]): 119-120.

Data are presented that show an increase in efficiency of an IMPATT diode after neutron irradiation. A theory explaining this effect is derived and compared with the experimental results. Less detailed data are also presented on variations of other diode parameters with neutron irradiation.

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Computer Design of Inhomogeneous Quarter-Wave Transformers (Correspondence)

T.D. Iveland. "Computer Design of Inhomogeneous Quarter-Wave Transformers (Correspondence)." 1969 Transactions on Microwave Theory and Techniques 17.2 (Feb. 1969 [T-MTT]): 120-121.

An impedance transformer consisting of cascaded quarter-wave sections of different impedance levels is said to be inhomogeneous when the impedance ratio of two sections depends on frequency. The synthesis problem has been treated by Young and Matthaei et al. for one and two sections, and by Riblet for an arbitrary number of sections. This contribution describes a cut-and-try method for design of inhomogeneous transformers. The usefulness of the method has been experimentally confirmed.

Abstracts

A Tunnel-Diode Harmonic-Mode Mixer (Correspondence)

B.A. Miller. "A Tunnel-Diode Harmonic-Mode Mixer (Correspondence)." 1969 Transactions on Microwave Theory and Techniques 17.2 (Feb. 1969 [T-MTT]): 121-124.

The theoretical and experimental investigation of a tunnel-diode harmonic-mode mixer which has an IF frequency given by the difference between the RF signal and the second harmonic of thle local oscillator frequency is described. This harmonic mode of operation would allow use of a local oscillator at a subharmonic rather than at the fundamental frequency in conventional superheterodyne receivers. The experimental S-band mixer built employs two directional filters which inherently lend themselves to terminating a tunnel diode. The mixer, which utilizes a germanium tunnel diode and 50-ohm terminations, exhibits low local oscillator power requirements and has a fairly low conversion loss. The theoretical investigation indicated possible means for improving the mixer performance.

Abstracts

An Oversize Waveguide Directional Coupler Using Two Prisms Interface-Matched by Means of the Brewster's-Angle Effect (Correspondence)

I. Takao and K. Watanabe. "An Oversize Waveguide Directional Coupler Using Two Prisms Interface-Matched by Means of the Brewster's-Angle Effect (Correspondence)." 1969 Transactions on Microwave Theory and Techniques 17.2 (Feb. 1969 [T-MTT]): 124-125.

A quasi-optical oversize waveguide directional coupler with two prisms that are interface-matched by menus of the Brewster's- angle effect is described. Experimental results showed that the coupler worked satisfactorily over the frequency range from 50 to 90 GHz.

Abstracts

Open Resonators with Rimmed Mirrors (Correspondence)

P.F. Checcacci and A.M. Scheggi. "Open Resonators with Rimmed Mirrors (Correspondence)." 1969 Transactions on Microwave Theory and Techniques 17.2 (Feb. 1969 [T-MTT]): 125-127.

Experimental tests performed on an X-band open resonator terminated by flat mirrors with step rims are described. The presence of the rim along the edges of the plane mirrors of a Fabry-Perot reduces the diffraction losses but does not greatly affect the mode volume. This may be advantageous especially in laser techniques.

Abstracts

Equivalent Circuit of a Series Gap in the Center Conductor of a Coaxial Transmission Line (Correspondence)

H.N. Dawirs. "Equivalent Circuit of a Series Gap in the Center Conductor of a Coaxial Transmission Line (Correspondence)." 1969 Transactions on Microwave Theory and Techniques 17.2 (Feb. 1969 [T-MTT]): 127-129.

When in 1963 I had occasion to make use of series gaps in the center conductor of a coaxial transmission line (Fig. 1) as a circuit element in some filters, I found that the common practice of considering the circuit equivalent of the gap as a capacitance in series with the center conductor would not give accurate results even with the latest refinements available for accurately calculating the value of the series capacitance. As a result, the location of cutoff frequencies, and hence of the passband and rejection band, could not be predicted as closely as desired, and the design procedure evolved into a cut-and-try procedure.

Abstracts

Contributors (Feb. 1969 [T-MTT])

P. Bernardi, J.J. Campbell, L.B. Felsen, T. Hayashi, W.R. Jones, K. Mikoshiba, R.S. Mueller, S. Nishida, E.W. Risley, Jr., F.J. Rosenbaum, I. Takao and H.Y. Yee. "Contributors (Feb. 1969 [T-MTT])." 1969 Transactions on Microwave Theory and Techniques 17.2 (Feb. 1969 [T-MTT]): 130-131.

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Mode Theory of Waveguide Filled with Warm Uniaxial Plasma

H.-S. Tuan. "Mode Theory of Waveguide Filled with Warm Uniaxial Plasma." 1969 Transactions on Microwave Theory and Techniques 17.3 (Mar. 1969 [T-MTT]): 134-137.

Characteristics of wave propagation in a guide filled with uniaxial anisotropic warm plasma are investigated. Basic equations of the plasma are derived. The validity of the plasma model and its physical significance are discussed. It has been found that TE modes are not affected by the presence of plasma. However, TM modes do have significant changes. Under the condition specified, each TM mode splits into two submodes. One has a low-frequency cutoff and the other propagates for all frequencies. The nature of power transfer in these modes is also investigated. A comparison of the effects as well as the physical significance of the changes due to cold and warm uniaxial plasma models are discussed.

Abstracts

360° Varactor Linear Phase Modulator

R.V. Garver. "360° Varactor Linear Phase Modulator." 1969 Transactions on Microwave Theory and Techniques 17.3 (Mar. 1969 [T-MTT]): 137-147.

Theory is presented which 1) derives the circuit impedance requirements to match the nonlinearity of the varactor reactance-versus-voltage curve to the tangent /spl theta/ curve to obtain 180° linear phase modulation from one diode; 2) gives the value and position of a resistor to make insertion loss invariant with phase; and 3) derives the circuit requirements for combining two 180° diode phase modulators in an admittance adding network to obtain 360° phase modulation. Experiments are disclosed rising series tuning at 1 GHz providing 360° phase modulation within ± 3.0 percent of linearity, and using shunt tuning at 5 GHz providing 360° phase modulation within ± 3.3 percent of linearity. A discussion is given of the application of the modulators to the serrodyne function.

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Scattering by a Cylindrical Post of Complex Permittivity in a Waveguide

E.D. Nielsen. "Scattering by a Cylindrical Post of Complex Permittivity in a Waveguide." 1969 Transactions on Microwave Theory and Techniques 17.3 (Mar. 1969 [T-MTT]): 148-153.

An exact solution of the discontinuity problem of a circular cylindrical post of arbitrary complex permittivity centered in a rectangular waveguide with the axis parallel to the electric field vector of the dominant mode has been set up and numerical results based directly on this solution have been found rising an electronic computer. The method used divides the waveguide up into three different regions by introducing two imaginary plane walls perpendicular to the waveguide walls. In the center region, which contains the cylindrical rod, the electromagnetic field is expanded in cylindrical waves and in the outer regions the field is expanded in waveguide modes. By setting up the boundary conditions at all discontinuity surfaces and performing numerical matching of the fields at the two imaginary walls, a system of linear equatious determining the coefficients of reflection, transmission, and absorption of the field due to the cylindrical rod is found. The structure which is of most interest in the case of a plasma column is a coaxial structure consisting of an inner dielectric cylinder with complex permittivity (the plasma) surrounded by a dielectric sleeve with real, positive permittivity (the glass tube). The theory is therefore developed to apply generally for such structures. From the numerical results, curves have been obtained showing the relationship between the coefficients of reflection and transmission and the (complex) permittivity of the rod material. Such curves maybe used for deducing the microwave properties of a cylindrical rod from measurements of the reflection and transmission coefficient of the rod.

Abstracts

Scattering of Electromagnetic Waves by a Cylinder Moving Along its Axis

D. Censor. "Scattering of Electromagnetic Waves by a Cylinder Moving Along its Axis." 1969 Transactions on Microwave Theory and Techniques 17.3 (Mar. 1969 [T-MTT]): 154-158.

The scattering of a time-harmonic, linearly polarized plane electromagnetic wave by a cylinder uniformly moving along its axis is discussed. The formalism is relativistically exact, and explicit forms are provided for first-order velocity effects. Consideration is given to both a cylinder moving in free space, using the procedure suggested by Einstein, and two refractive media; it is veritied that the first case is a special case of the second one. Thin scatterers are considered and it is shown that no first-order velocity effects are present. For a moving medium, having in its rest frame the same constitutive parameters as the surrounding medium, it is shown that the velocity-independent part vanishes, but scattered fields of the first order in the velocity are still present. Moreover, these waves appear with the opposite polarization (compared to the incident wave).

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Dispersion Characteristics of an Open Interdigital-Line Structure

P.-R. Wu. "Dispersion Characteristics of an Open Interdigital-Line Structure." 1969 Transactions on Microwave Theory and Techniques 17.3 (Mar. 1969 [T-MTT]): 159-163.

The dispersion characteristics of an open interdigital-line structure were obtained by treating the structure as a radiator. Good agreement between the theoretical solution and the experimental measurements was observed.

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On the Properties of Warm-Plasma-Filled Rectangular Waveguide with Strong Transverse Magnetic Field (Correspondence)

H.-S. Tuan. "On the Properties of Warm-Plasma-Filled Rectangular Waveguide with Strong Transverse Magnetic Field (Correspondence)." 1969 Transactions on Microwave Theory and Techniques 17.3 (Mar. 1969 [T-MTT]): 164-165.

Characteristics of electromagnetic wave propagation in a reetangular waveguide filled with uniaxial anisotropic warm plasma are investigated. The static magnetic field is assumed to be transverse to the guide axis. It is found that propagating modes are conveniently classified into TE and TM modes with respect to the direction of static magnetic field. The properties of TE modes are found to be the same as those of ordinary hybrid modes in air-filled guide. However, the uniaxial warm plasma has a significant effect on the propagation characteristics of TM modes.

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Effect of Transmission Line Mismatch on Cavity Q, with Particular Application to Ferrite Dielectric Loss Measurements (Correspondence)

I. Bady. "Effect of Transmission Line Mismatch on Cavity Q, with Particular Application to Ferrite Dielectric Loss Measurements (Correspondence)." 1969 Transactions on Microwave Theory and Techniques 17.3 (Mar. 1969 [T-MTT]): 165-166.

An analysis is made of the effect of mismatches in the transmission lines and components connecting a cavity on the loaded Q of the cavity. It is shown that the loaded Q can be higher or lower than the Q that would be obtained io the absence of a mismatch. These results are applied to the measurement of the dielectric loss tangent of ferrites.

Abstracts

Linearly Tapered Transmission Line and its Application in Microwaves (Correspondence)

O.P. Rustogi. "Linearly Tapered Transmission Line and its Application in Microwaves (Correspondence)." 1969 Transactions on Microwave Theory and Techniques 17.3 (Mar. 1969 [T-MTT]): 166-168.

There has been a considerable amount of work utilizing both single sections and coupled sections of nonuniform transmission lines. Various types of nonuniformities have been dealt with to obtain ultra-cavity broad-band microwave components. In this correspondence the results of an investigation of linearly tapered transmission lines are presented.

Abstracts

Optimal Design of Coaxial Low-Pass Filters (Correspondence)

G.R. Haack. "Optimal Design of Coaxial Low-Pass Filters (Correspondence)." 1969 Transactions on Microwave Theory and Techniques 17.3 (Mar. 1969 [T-MTT]): 169-170.

This correspondence presents a method for designing coaxial low-pass filters with unequal line lengths to have an equal-ripple passband insertion loss. Mathematical optimization techniques are used to improve an approximate filter design and achieve a response which is very nearly equal-ripple in the passband.

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Rectangular Waveguide-to-Coax Line Transitions: 1968 (Correspondence)

M.M. Brady. "Rectangular Waveguide-to-Coax Line Transitions: 1968 (Correspondence)." 1969 Transactions on Microwave Theory and Techniques 17.3 (Mar. 1969 [T-MTT]): 170-170.

The ordinary transition between waveguide and coaxial transmission lines is often a component which is taken for granted, yet also often the one which limits the bandwidth, match, or maximum power attainable in a composite system. Two typical production transitions for familiar waveguide sizes are shown in Fig. 1 to illustrate the similarity in construction techniques. The one on the left is for 153 IEC-R 100 (U. S. EIA WR-90) waveguide as commonly used for marine radar and for microwave laboratory courses. The one on the right is for 153 IEC-R 6 (U. S. EIA WR-1500) as used for military communications and UHF TV systems.

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Avalanche Diode Superregenerative Amplifier (Correspondence)

P. Ver Planck. "Avalanche Diode Superregenerative Amplifier (Correspondence)." 1969 Transactions on Microwave Theory and Techniques 17.3 (Mar. 1969 [T-MTT]): 171-172.

A commercial X-band avalanche diode oscillator was operated as a super-regenerative amplifier by coupling a 1O-MHz current into the diode's biasing loop. Some frequency response characteristics noted during multiresonant operation which could not be explained using conventional superregenerative-amplifier theory are believed due to diode susceptance modulation.

Abstracts

The Effect of Capacitive-Screw Turners on Waveguide Loss (Correspondence)

C.T. Stelzried. "The Effect of Capacitive-Screw Turners on Waveguide Loss (Correspondence)." 1969 Transactions on Microwave Theory and Techniques 17.3 (Mar. 1969 [T-MTT]): 172-173.

Waveguide dissipative loss is a critical factor in the performance of a low-noise receiving system. Precision calibrations require that the waveguide system be well matched. This is easily accomplished with multiple capacitive-screw tuners. The effect of screw tuners on waveguide loss has been studied by making microwave loss measurements on a waveguide test fixture with and without insertion of the tuning screws. The increase in dissipative loss for two copper and two nickel-plated brass ¼-inch-diameter tuning screws was 0.0003 and 0.0022 dB, respectively, at 2295 MHz. This result indicates the advantage of copper screw tuners for reducing waveguide dissipative loss.

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Attenuation and Guidance of Modes on Hollow Dielectric Waveguides (Correspondence)

J.I. Glaser. "Attenuation and Guidance of Modes on Hollow Dielectric Waveguides (Correspondence)." 1969 Transactions on Microwave Theory and Techniques 17.3 (Mar. 1969 [T-MTT]): 173-174.

The approximate theory of norrnal mode propagation on large circular hollow dielectric waveguides has been previously published by Marcatili and Schmelzer. This letter reports two results obtained from a computer analysis of the exact transcendental equation for the propagation constants of the normal modes. The geometry of the wavegulde is shown in Fig. 1.

Abstracts

The Australian National Standards Laboratory X-Band Radiometer for the Calibration of Noise Sources (Corrections)

P.I. Somlo and D.L. Hollway. "The Australian National Standards Laboratory X-Band Radiometer for the Calibration of Noise Sources (Corrections)." 1969 Transactions on Microwave Theory and Techniques 17.3 (Mar. 1969 [T-MTT]): 174-174.

The authors regret that that some of the figures published in the above paper erroneously refer to a version of a hot load standard no longer in use. To make the article consistent with Fig. 2, the following changes are necessary:

Abstracts

The Effect of Mismatched Components on Microwave Noise-Temperature Calibrations (Corrections)

T.Y. Otoshi. "The Effect of Mismatched Components on Microwave Noise-Temperature Calibrations (Corrections)." 1969 Transactions on Microwave Theory and Techniques 17.3 (Mar. 1969 [T-MTT]): 174-174.

The author of the above paper has called the following to the attention of the Editor.

Abstracts

Contributors (Mar. 1969 [T-MTT])

D. Censor, R.V. Garver, E.D. Nielsen, H.-S. Tuan and P.-R. Wu. "Contributors (Mar. 1969 [T-MTT])." 1969 Transactions on Microwave Theory and Techniques 17.3 (Mar. 1969 [T-MTT]): 175-175.

Abstracts

Information for Authors (Mar. 1969 [T-MTT])

"Information for Authors (Mar. 1969 [T-MTT])." 1969 Transactions on Microwave Theory and Techniques 17.3 (Mar. 1969 [T-MTT]): 176-176.

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Table of Contents (Apr. 1969 [T-MTT])

"Table of Contents (Apr. 1969 [T-MTT])." 1969 Transactions on Microwave Theory and Techniques 17.4 (Apr. 1969 [T-MTT]): 177-177.

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Abstracts

The Stepped Digital Elliptic Filter

J.D. Rhodes. "The Stepped Digital Elliptic Filter." 1969 Transactions on Microwave Theory and Techniques 17.4 (Apr. 1969 [T-MTT]): 178-184.

The design and synthesis of various types of microwave elliptic function filters has been accomplished by a number of authors. However, one problem in this field which remains is the realization of compact narrow-band bandpass elliptic function filters. In this paper, a procedure is presented which enables this class of filters to be constricted in a compact digital form. Since the physical realization is in the form of an n-wire line, one-quarter of a wavelength long at the center frequency of the passband, where the impedance levels are stepped along the center of the coupled lines, the filter has been termed the stepped digital elliptic filter. The absence of awkward interconnections in the filter due to the stepped digital structure inherently implies that reasonable insertion loss characteristics may be achieved in the X-band region and above, and also simplifies the mechanical construction. It is shown that the resonant elements in the filter, due to the design procedure adopted, are relatively insensitive to the absolute bandwidth of the filter, and consequently fractional bandwidths of approximately 30 percent and below may be readily achieved while the normalized impedance values of the elements in the network remain of the order of unity. This latter result is similar to that obtainable from conventional interdigital filters but in the case of narrow bandwidths the stepped digital filter is considerably smaller in physical size. A systematic procedure is also formulated for the inclusion of the parasitic lumped end effect capacitances into the overall design procedure in order to maintain the equiripple passband and stopband responses. Experimental results are presented for a five-element, 11 percent bandwidth filter and are shown to be in good agreement with theoretical predictions.

Abstracts

A High-Resolution Swept-Frequency Reflectometer

D.L. Hollway and P.I. Somlo. "A High-Resolution Swept-Frequency Reflectometer." 1969 Transactions on Microwave Theory and Techniques 17.4 (Apr. 1969 [T-MTT]): 185-188.

A simple swept-frequency reflectometer is described that is capable of measuring reflection coefficients as low as 0.001 and is particularly suitable for precise impedance matching. With the exception of a length of accurate plain waveguide, used as a standard, the instrument contains no critical components and requires no tuning adjustments. The reflection coefficient is displayed on an oscilloscope or X-Y recorder on an almost linear scale that is only slightly affected by departures from square-law detection.

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Abstracts

The Design and Synthesis of a Class of Microwave Bandpass Linear Phase Filters

J.D. Rhodes. "The Design and Synthesis of a Class of Microwave Bandpass Linear Phase Filters." 1969 Transactions on Microwave Theory and Techniques 17.4 (Apr. 1969 [T-MTT]): 189-204.

This paper is concerned with the design procedure and synthesis of a class of microwave bandpass linear phase filters which simultaneously exhibit a maximally flat amplitude and delay response about band center. In the first part of the paper a systematic procedure is developed for the construction of a nonminimum phase transfer function which exhibits a maximally flat delay and maximally flat amplitude characteristic. In the second part, a synthesis procedure is presented for the realization of the general nth-ordered transfer function by a generalized interdigital network. To simplify the design and construction of this filter, typical characteristics for filters of degree n = 3,4,5,6,7 are graphically presented together with a tabular representation of the polynomials which are required to design the filter. Finally, the results of an experimental filter of degree 3 are incorporated to illustrate that this class of nonminimum phase filters may readily be constructed in practice.

Abstracts

A General High-Order Finite-Element Waveguide Analysis Program

P. Silvester. "A General High-Order Finite-Element Waveguide Analysis Program." 1969 Transactions on Microwave Theory and Techniques 17.4 (Apr. 1969 [T-MTT]): 204-210.

A very general computer program for determining sets of propagating modes and cutoff frequencies of arbitrarily shaped waveguides is described. The program uses a new method of analysis based on approximate extremization of a functional whose Euler equation is the scalar Helmholtz equation, subject to homogeneous boundary conditions. Subdividing the guide cross section into triangular regions and assuming the solution to be representable by a polynomial in each region, the variational problem is approximated by a matrix eigenvalue problem, which is solved by Householder tridiagonalization and Sturm sequences. For reasonably simple convex polygonal guide shapes, the dominant eigenfrequencies are obtained to 5-6 significant figures; for nonconvex or complicated shapes, the accuracy may fall to 3 significant figures. Use of the program is illustrated by calculating the propagating modes of a class of degenerate mode guides of current interest, for which experimental data are available. Numerical studies of convergence rate and discretization error are also described. It is believed that the new program produces waveguide analyses of higher accuracy than any general program previously available.

Abstracts

Fields in Waveguide Bends Expressed in Terms of Coupled Local Annular Waveguide Modes

E. Bahar. "Fields in Waveguide Bends Expressed in Terms of Coupled Local Annular Waveguide Modes." 1969 Transactions on Microwave Theory and Techniques 17.4 (Apr. 1969 [T-MTT]): 210-217.

The fields in waveguide bends with arbitrary curvature and cross section are expressed in terms of "local" annular modes. The coupling between the local mode amplitudes is derived by evaluating the differential scattering coefficients between two adjacent infinitesimal annular waveguides. Comparison of these solutions with an earlier analysis of the problem shows that the coupling terms for the local annular modes are smaller for gradually curved bends since they are proportional to the derivative of the curvature. Furthermore, the significant scattered annular modes are bunched more tightly about the incident mode. The coupled differential equations for the annular mode amplitudes may therefore be solved by considering relatively fewer scattered modes.

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Design and Computed Theoretical Performance of Three Classes of Equal-Ripple Nonuniform Line Couplers

C.P. Tresselt. "Design and Computed Theoretical Performance of Three Classes of Equal-Ripple Nonuniform Line Couplers." 1969 Transactions on Microwave Theory and Techniques 17.4 (Apr. 1969 [T-MTT]): 218-230.

The purpose of this paper is to provide an accurate theoretical picture of three classes of tapered-line couplers. The coupler taper is approximated with a cascade of short equal-length coupled line segments whose coupling values match those of the taper at one end of each segment. Exact analysis of the even-mode transmission-line analogy is then performed by evaluating the ABCD matrix of the cascade as a function of frequency with the aid of a digital computer. The computed response converges to that of the smooth tapered coupler as the number of line segments increases, total length being held constant. An exact asymptotic high-frequency model for asymmetric couplers is presented which provides improved prediction of coupler performance, as verified by computer analysis. The associated design procedures are given explicitly. The insertion phase dispersion of the 90° and /spl Sigma/ - /spl Delta/ magic tee devices is treated. Comparisons with the insertion phase dispersion of various stepped coupling 90° designs are provided.

Abstracts

X-Band Ferrite-Varactor Limiter (Correspondence)

J.L. Carter and J.W. McGowan. "X-Band Ferrite-Varactor Limiter (Correspondence)." 1969 Transactions on Microwave Theory and Techniques 17.4 (Apr. 1969 [T-MTT]): 231-232.

A ferrite-varactor limiter combination operating at X band has been investigated. The ferrite limiter employs a combination of polycrystalline YIG for dynamic range and single-crystal YIG for reduced threshold. Various design techniques employing ridge waveguide and dielectric loaded ferrite limiters were studied. The ferrite-varactor package has a threshold of about 30 mW and a dynamic range up to 10 kW. The overall insertion loss is less than 1.0 dB in the frequency range of 8.9 to 9.5 GHz. The flat leakage is about 30 mW and the spike leakage energy is less than 0.3 erg at 10 kW of peak power input.

Abstracts

Precision Insertion-Loss Calibrations at 90 GHz (Correspondence)

C.T. Stelzried and D.A. Oltmans. "Precision Insertion-Loss Calibrations at 90 GHz (Correspondence)." 1969 Transactions on Microwave Theory and Techniques 17.4 (Apr. 1969 [T-MTT]): 233-234.

A dual charnel insertion-loss test set with an accuracy of ahout 10/sub -4/ dB has been constructed for the critical calibrations required in many phases of radio astronomy and communications systems. The commercially available test sets use 40-GHz balanced detector mounts for the power meters whch did not give satisfactory performance at 90 GHz. Thermistor mounts for the test set constructed have been assembled from commercially available 90-GHz components (WR 12 wavegrride band). The necessary thermistor thermal balance for the mounts is achieved with a fine paint spray on the reference thermistor with no loss n sensitivity. The short term instability (15 minutes) of the power meter has been reduced from about 2.0 to 0.2 µW. This results in short stability for the insertion-loss test set of about 0.0004 dB at 90 GHz.

Abstracts

Radiation from Microstrip Resonators (Correspondence)

E.J. Denlinger. "Radiation from Microstrip Resonators (Correspondence)." 1969 Transactions on Microwave Theory and Techniques 17.4 (Apr. 1969 [T-MTT]): 235-236.

This correspondence illustrates the fractional amount of power radiated from two commonly used microstrip resonators, namely, the disc and the transmission-line resonator. An empirical formula was derived for radiation from the latter type of resonator.

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Applications of Lagrange Expansion to the Problem of Shielded Surface Waves (Correspondence)

Y.-C. Wang. "Applications of Lagrange Expansion to the Problem of Shielded Surface Waves (Correspondence)." 1969 Transactions on Microwave Theory and Techniques 17.4 (Apr. 1969 [T-MTT]): 236-237.

Barlow and Wait showed that surface waves may be shielded in parallel impedance-surfaces. Considering TM modes propagating in the x direction in air between two surfaces in the xz plane with surface impendances...

Abstracts

Improved Mode Filters for Oversized Rectangular Waveguides (Correspondence)

P. Bernardi. "Improved Mode Filters for Oversized Rectangular Waveguides (Correspondence)." 1969 Transactions on Microwave Theory and Techniques 17.4 (Apr. 1969 [T-MTT]): 237-238.

A mode filter is considered for TE/sub mn/ and TM/sub mn/ modes with n/spl ne/0 in oversized rectangular waveguides. A previous analysis carried out for the case of a purely resistive sheet placed in the guide is extended to the case of sheets having a complex surface impedance.

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E. Bahar, D.L. Hollway, J.D. Rhodes, P. Silvester, P.I. Somlo and C.P. Tresselt. "Contributors (Apr. 1969 [T-MTT])." 1969 Transactions on Microwave Theory and Techniques 17.4 (Apr. 1969 [T-MTT]): 239-239.

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"Table of Contents (May 1969 [T-MTT])." 1969 Transactions on Microwave Theory and Techniques 17.5 (May 1969 [T-MTT]): 241-241.

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On the Analysis of General Parallel Coupled TEM Structures Including Nonadjacent Couplings

C.-L. Ren. "On the Analysis of General Parallel Coupled TEM Structures Including Nonadjacent Couplings." 1969 Transactions on Microwave Theory and Techniques 17.5 (May 1969 [T-MTT]): 242-249.

In this paper a rigorous but relatively straightforward procedure is presented for obtaining equivalent circuits of general parallel coupled TEM transmission lines that includes coupling to adjacent as well as nonadjacent lines. The procedure is illustrated in detail by several examples. It provides a means of analyzing these structures without the need of neglecting coupling between any nonadjacent lines and is therefore particularly helpful in the case where the nonadjacent couplings become significant. In fact, for obtaining optimum device performance from a given number of lines, it may be desirable to include the nonadjacent couplings. As an illustration of its usefulness in an exact analysis, the proposed method is applied to the analysis of interdigital filters. It is demonstrated that certain properties can be shown to exist when nonadjacent couplings are included.

Abstracts

Guided Waves in Inhomogeneous Focusing Media Part II: Asymptotic Solution for General Weak Inhomogeneity

C.N. Kurtz and W. Streifer. "Guided Waves in Inhomogeneous Focusing Media Part II: Asymptotic Solution for General Weak Inhomogeneity." 1969 Transactions on Microwave Theory and Techniques 17.5 (May 1969 [T-MTT]): 250-253.

In this paper asymptotic methods are employed to solve for the vector fields and propagation constants of modes propagating axially in a circular-cylindrical guiding system in which the dielectric constant decreases gradually and monotonically, but otherwise arbitrarily, from a maximum at the axis.

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Abstracts

The Effect of Neighboring Conductors on the Currents and Fields in Plane Parallel Transmission Lines

M.E. Hellman and I. Palocz. "The Effect of Neighboring Conductors on the Currents and Fields in Plane Parallel Transmission Lines." 1969 Transactions on Microwave Theory and Techniques 17.5 (May 1969 [T-MTT]): 254-259.

In this paper the current distribution is calculated for a microstrip line in the presence of a neighboring strip. The electric field is calculated and the characteristic impedance of the slotted microstrip line is determined. A graph of characteristic impedance is given for odd and even excitations. The calculations are carried out by setting up a singular integral equation which is solved using a finite integral transform. This method has the advantage that the calculations can be generalized in a straightforward manner for the multislotted line.

Abstracts

From Approximations to Exact Relations for Characteristic Impedances

W. Hilberg. "From Approximations to Exact Relations for Characteristic Impedances." 1969 Transactions on Microwave Theory and Techniques 17.5 (May 1969 [T-MTT]): 259-265.

Approximations for the characteristic impedance of a special two conductor stripline and for the general function K/K' are derived by a transformation method recently described in the literature; the first, second, and third approximations having a greatest relative error of the order of 10/sup -3/, 10/sup -6/, and 10/sup -12/, respectively. They can be introduced into an algorithm which is based on elementary conformal mappings, and thus further approximations with rapidly vanishing errors can be derived. The results agree with those for the function K/K' obtained by elliptic integral theory. Obviously no such theory is needed to calculate characteristic impedances or the function K/K' with arbitrary accuracy. The advantages of the new method are illustrated for shielded coupled-strip transmission lines, for which an extended diagram with extreme parameter values has been worked out.

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Abstracts

Mode Coupling Between Surface Wave Transmission Lines

K.R. Cook and T.-M. Chu. "Mode Coupling Between Surface Wave Transmission Lines." 1969 Transactions on Microwave Theory and Techniques 17.5 (May 1969 [T-MTT]): 265-270.

The eigenvalue equation describing the mode coupling between two Goubau surface wave lines is derived utilizing the point matching method for solutions of boundary value problems. Excellent agreement is obtained between theoretical and experimental results. A method for obtaining the hybrid wavenumbers of coupled surface wave lines is proposed for a finite set of TE and TM modes.

Abstracts

Dielectric-Shielded G-Line

J.E. Partch. "Dielectric-Shielded G-Line." 1969 Transactions on Microwave Theory and Techniques 17.5 (May 1969 [T-MTT]): 271-274.

A dielectric shield is proposed to protect a G-line from environmental conditions, such as ice, without altering the basic characteristics of the surface wave. A solution is obtained for a multilayered cylindrical surface waveguide and is used to predict the guide wavelength and attenuation rate of a dielectric-shielded G-line and the effect of a layer of ice, which can be very detrimental to the performance of a G-line. A dielectric shield is shown to effectively protest the G-line without appreciably changing its transmission characteristics. Experimental confirmation of the calculations is demonstrated.

Abstracts

A 350-MHz Broad-Band Lumped Element Circulator as a Protective Isolator (Correspondence)

E. Fliegler. "A 350-MHz Broad-Band Lumped Element Circulator as a Protective Isolator (Correspondence)." 1969 Transactions on Microwave Theory and Techniques 17.5 (May 1969 [T-MTT]): 275-277.

Recent reports have shown the feasibility of using miniature lumped element circulators in the VHF and UHF frequency ranges. This correspondence describes the broad-banded performance of a miniature UHF circulator with a passband of 300 to 400 MHz using a device manufactured by Melabs -- their model LB-1 "isoductor."

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Abstracts

Conversion of TE/sub 11/° Mode by a Large Diameter Conical Junction (Correspondence)

K. Tomiyasu. "Conversion of TE/sub 11/° Mode by a Large Diameter Conical Junction (Correspondence)." 1969 Transactions on Microwave Theory and Techniques 17.5 (May 1969 [T-MTT]): 277-279.

If a TE/sub 11/° mode is incident on a large diameter conical junction, the first-order forward scattered modes required to match the curved phase front of the TE/sub 11/° mode are the TM/sub 11/° and TE/sub 12/° modes, and the second-order modes are the TM/sub 12/° and TE/sub 13/° modes. All of the higher order modes have transverse electric fields that are in phase quadrature with that of the TE/sub 11/° mode at the junction. A time-shared computer was employed to determine the relative amplitudes of the higher order modes required to match the TE/sub 11/°-mode curved phase front. It is assumed that 1) the change in cone angle is small, and 2) the cone diameter is much larger than the wavelength. After matching the curved phase front by the four higher order modes, the residual error was found to be negligible. Finally, the mode amplitudes are converted into mode power levels.

Abstracts

Propagation of Electromagnetic Waves in Rectangular Guide Filled with a Semiconductor in the Presence of a Transverse Magnetic Field (Correspondence)

S.A. Rahman and M.W. Gunn. "Propagation of Electromagnetic Waves in Rectangular Guide Filled with a Semiconductor in the Presence of a Transverse Magnetic Field (Correspondence)." 1969 Transactions on Microwave Theory and Techniques 17.5 (May 1969 [T-MTT]): 279-281.

A general analysis is given for the determination of the field components and the propagation constant of electromagnetic waves propagating in a semiconductor filled rectangular waveguide subjected to a uniform transverse steady magnetic field.

Abstracts

Frequency Measurements in the Far Infrared: Limitations Imposed by the Noise Spectrum in Harmonic Mixing (Correspondence)

L. Frenkel and T. Sullivan. "Frequency Measurements in the Far Infrared: Limitations Imposed by the Noise Spectrum in Harmonic Mixing (Correspondence)." 1969 Transactions on Microwave Theory and Techniques 17.5 (May 1969 [T-MTT]): 281-282.

Beat frequencies resulting from several orders of mixing of the power of two klystrons have been studied on a spectrum analyzer. The 5th-order beat note of klystrons operating at 130 and 65 GHz, respectively, has been counted directly. It is found that higher order beats are generally buried in the noise but that the frequency average can be accurately determined.

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Abstracts

A Graph of Return Loss Versus Frequency for Quarter-Wavelength Short-Circuited Waveguide Impedance Standards (Correspondence)

R.W. Beatty and B.C. Yates. "A Graph of Return Loss Versus Frequency for Quarter-Wavelength Short-Circuited Waveguide Impedance Standards (Correspondence)." 1969 Transactions on Microwave Theory and Techniques 17.5 (May 1969 [T-MTT]): 282-284.

Formnlas and a graph are presented for determining return losses of microwave impedance standards consisting of quarter- wavelength sections of short-circuited waveguide. Most standard sizes of coaxial line and rectangular waveguide are included on the graph, which covers a frequency range from 0.2 to 330 GHz. The graph is based upon a conductivity of 10/sup 7/ mho/m. Values of return loss read from the graph must then be divided by the square root of the actual conductivity normalized to the above value. A table of bulk conductivities of various metals is given.

Abstracts

Propagation in Rectangular Waveguide Partially Filled with an Inhomogeneous Dielectric (Correspondence)

G. Gonzalez and D.C. Stinson. "Propagation in Rectangular Waveguide Partially Filled with an Inhomogeneous Dielectric (Correspondence)." 1969 Transactions on Microwave Theory and Techniques 17.5 (May 1969 [T-MTT]): 284-286.

A closed form solution for the TE/sub lo/ mode in a rectangular waveguide partially filled with an inhomogeneous dielectric is obtained. The inhomogeneous dielectric is assumed to vary exponentially in one transverse direction. A graphical technique for obtaining the cutoff frequencies is given. The longitudinal section magnetic mode (LSM) is briefly considered.

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Abstracts

Coupled Microstrip-Line Varactor Doublers (Correspondence)

E.F. Belohoubek and A. Rosen. "Coupled Microstrip-Line Varactor Doublers (Correspondence)." 1969 Transactions on Microwave Theory and Techniques 17.5 (May 1969 [T-MTT]): 286-288.

Microstrip varactor doublers using thin-film coupled lines on a ceramic substrate are described. Typical results achieved for L- to S-baud doublers include a CW power output of 5 watts over a 10 percent bandwidth at a minimum efficiency of 43 percent; at lower power level, a bandwidth of 31 percent at a minimum efficiency of 30 percent was achieved by use of five coupled lines.

Abstracts

On Mode Conversion in Overmoded Waveguide Tapers (Correspondence)

G. Poulton, A.E. Karbowiak and C.C.H. Tang. "On Mode Conversion in Overmoded Waveguide Tapers (Correspondence)." 1969 Transactions on Microwave Theory and Techniques 17.5 (May 1969 [T-MTT]): 288-289.

This correspondence is concerned with some discrepancies which we have noted between equations which were obtained for rectangular tapers and those of generalized geometry. In the course of our investigations of mode conversion phenomena in generalized tapers of arbitrary geometry, we have used the following generalized telegraphist's equations for the equivalent voltages and currents in overmoded waveguides.

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Analysis of Practical Branch-Guide Directional Couplers (Correspondence)

R. Levy. "Analysis of Practical Branch-Guide Directional Couplers (Correspondence)." 1969 Transactions on Microwave Theory and Techniques 17.5 (May 1969 [T-MTT]): 289-290.

Close agreement between experimental results aad theory is reported for waveguide branch-guide couplers when proper account is taken of the T-junction discontinuities. The appropriate range of specifications for which these couplers are particularly apt is indicated.

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Contributors (May 1969 [T-MTT])

T.-M. Chu, K.R. Cook, M.E. Hellman, W. Hilberg, C.N. Kurtz, I. Palocz, J.E. Partch, C.-L. Ren and W. Streifer. "Contributors (May 1969 [T-MTT])." 1969 Transactions on Microwave Theory and Techniques 17.5 (May 1969 [T-MTT]): 291-292.

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Abstracts

The Theory of the Point-Matching Method for Perfectly Conducting Waveguides and Transmission Lines

R.H.T. Bates. "The Theory of the Point-Matching Method for Perfectly Conducting Waveguides and Transmission Lines." 1969 Transactions on Microwave Theory and Techniques 17.6 (Jun. 1969 [T-MTT]): 294-301.

An improved theory of the point-matching method for perfectly conducting waveguides is presented. Some simplified formulas are developed. A point-matching technique is developed for computing the Z/sub 0/ of TEM lines, and established for waveguides and transmission lines with multiple connected and multiple valued cross sections. Sample computations are presented.

Abstracts

A Modified Residue-Calculus Technique for Solving a Class of Boundary Value Problems Part I: Waveguide Discontinuities

G.F. VanBlaricum, Jr. and R. Mittra. "A Modified Residue-Calculus Technique for Solving a Class of Boundary Value Problems Part I: Waveguide Discontinuities." 1969 Transactions on Microwave Theory and Techniques 17.6 (Jun. 1969 [T-MTT]): 302-309.

The modified residue-calculus technique, which is a generalization of the conventional function theoretic procedure for solving certain infinite sets of equations, permits solution of waveguide discontinuity problems which include dielectric, diaphragm, and step modifications of a basic discontinuity problem exactly solvable by the Wiener-Hopf techniqne. Solutions in scattering matrix form, including both propagating and nonpropagating modes, are found by a rapidly convergent and very accurate numerical procedure which eliminates many of the computational difficulties associated with integral equation or matrix equation solutions of the same problems.

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A Modified Residue-Calculus Technique for Solving a Class of Boundary Value Problems-Part II: Waveguide Phased Arrays, Modulated Surfaces, and Diffraction Gratings

G.F. VanBlaricum, Jr. and R. Mittra. "A Modified Residue-Calculus Technique for Solving a Class of Boundary Value Problems-Part II: Waveguide Phased Arrays, Modulated Surfaces, and Diffraction Gratings." 1969 Transactions on Microwave Theory and Techniques 17.6 (Jun. 1969 [T-MTT]): 310-319.

The modified residue-calculus technique (MRCT) described in a companion paper may be combined with scattering matrix, multiple-reflection techniques to provide solutions in scattering matrix form to thick-wall waveguide phased array, modulated surface, and strip grating geometries. Each of these geometries may be regarded as a periodic array of thin plates modified by dielectric fillings, waveguide steps, and terminations. Solutions to the modified geometries are found by combining the exact solution to the thin-wall array problem with approximate solutions to certain waveguide discontinuity problems found by the MRCT. In particular, a value of the dominant mode reflection coefficient versus scan angle for the thick-wall array may be found accurate to two or three significant figures without need for matrix inversion. In general, reduction of matrix size by a factor of 5 or more over conventional methods with equivalent accuracy may be realized.

Abstracts

An Analytical Study of the Echelette Grating with Application to Open Resonators

T. Itoh and R. Mittra. "An Analytical Study of the Echelette Grating with Application to Open Resonators." 1969 Transactions on Microwave Theory and Techniques 17.6 (Jun. 1969 [T-MTT]): 319-327.

Reflection coefficients of various order diffracted waves are calculated for an echelette grating which finds important use as a component of suboptical resonators. The classical optics approach has been found to be inadequate for deriving reliable results for this configuration. Accurate solution of the boundary value problem associated with the echelette grating is derived by a new method. The results are useful for the design of suboptical resonators which use the echelette grating as a coupling mirror to achieve a single wavelength operation.

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Abstracts

Analysis of Lossy Symmetrical Three-Port Networks with Circulator Properties

S. Hagelin. "Analysis of Lossy Symmetrical Three-Port Networks with Circulator Properties." 1969 Transactions on Microwave Theory and Techniques 17.6 (Jun. 1969 [T-MTT]): 328-333.

The properties of three-port networks have been widely discussed in connection with circulator development. However, much attention has not been paid to the influence of loss on network properties. The purpose of this paper is to analyze the relations between the scattering coefficients in a lossy rotation-symmetrical three-port network. The results are presented in several curves showing the realizable combinations of scattering coefficients for different states of loss. Special consideration given to networks with circulator properties.

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Microwave Frequency Multiplication Using Hot Electrons in Semiconductors

Y. Machi. "Microwave Frequency Multiplication Using Hot Electrons in Semiconductors." 1969 Transactions on Microwave Theory and Techniques 17.6 (Jun. 1969 [T-MTT]): 333-338.

The subject of this paper is microwave frequency multiplication by hot carriers in bulk semiconductors which show nonlinear current-voltage characteristics. The fifth, seventh, and ninth harmonics are measured, the fundamental frequeucy being in the X-band. Efficiencies are obtained which are higher than those obtained so far with point-contact multipliers and gas discharge tubes. In addition, higher input power can be applied, and the assembly of a hot carrier multiplier is simpler and more economical than others.

Abstracts

Measurement of Short Time Changes of Cavity Q and Resonant Frequency

K.R. Richter. "Measurement of Short Time Changes of Cavity Q and Resonant Frequency." 1969 Transactions on Microwave Theory and Techniques 17.6 (Jun. 1969 [T-MTT]): 339-344.

A method for the determination of short time changes of Q factor and resonance of a cavity has been developed. The method is based on the observation of the change in reflection coefficient. As long as the cavity is coupled undercritically there always exist two frequencies at which no change of the reflection coefficient occurs. The measurement of these frequencies is sufficient for evaluating the changed values of the unloaded Q and the resonant frequency assuming no change of the external Q during perturbation. This assumption can be made in most cases of application. If there also exists a perturbation of the external Q, the value of the changed reflection coefficient must be measured at any additional freqnency preferably at the resonant frequency of the unperturbed cavity. Experimental results demonstrate the applicability of this method.

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Design Parameters for Overdriven Varactor Frequency Doublers Using Punch-Through or Bimode Varactors (Correspondence)

A.I. Grayzel. "Design Parameters for Overdriven Varactor Frequency Doublers Using Punch-Through or Bimode Varactors (Correspondence)." 1969 Transactions on Microwave Theory and Techniques 17.6 (Jun. 1969 [T-MTT]): 345-347.

Design parameters for frequency doublers usiug "idealized" punch-through varactors have been given in the literature. This correspondence gives design parameters for "realizable" punch-through or bi-mode varactor doublers.

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An Interesting Pulling Effect in a Tunnel Diode Oscillator (Correspondence)

J.A. Mashock and T.K. Ishii. "An Interesting Pulling Effect in a Tunnel Diode Oscillator (Correspondence)." 1969 Transactions on Microwave Theory and Techniques 17.6 (Jun. 1969 [T-MTT]): 347-348.

The fundamental freqnency of a tunnel diode oscillator (800 MHz) was pulled by a signal injected in the neighborhood of its ninth harmonic (7.2 GHz). With an injected signal of +0 dBm a frequency shift of 1.3 MHz was observed. The oscillator output power level was +10 dBm.

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Contributors (Jun. 1969 [T-MTT])

R.H.T. Bates, S.I. Hagelin, T. Itoh, Y. Machi, R. Mittra, K.R. Richter and G.F. VanBlaricum, Jr.. "Contributors (Jun. 1969 [T-MTT])." 1969 Transactions on Microwave Theory and Techniques 17.6 (Jun. 1969 [T-MTT]): 349-349.

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A Frequency-Stabilized Microwave Band-Rejection Filter Using High Dielectric Constant Resonators

M.A. Gerdine. "A Frequency-Stabilized Microwave Band-Rejection Filter Using High Dielectric Constant Resonators." 1969 Transactions on Microwave Theory and Techniques 17.7 (Jul. 1969 [T-MTT]): 354-359.

The high permittivity dielectric resonator is a low loss microwave filter element whose size is substantiality less than metal waveguide cavities. Temperature stabilizing their resonant frequency increases the applicability of such elements. A temperature compensated 3-section band-rejection filter using dielectric resonators has been fabricated and tested. The measured electrical performance was comparable to metal waveguide filters and the frequency stability for temperature variations was comparable to brass waveguide cavity filters which are not temperature compensated.

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Guided Waves in Inhomogeneous Focusing Media Part III: Wall Effects, Losses, and the Transition from Fast to Slow Waves

C.N. Kurtz and W. Streifer. "Guided Waves in Inhomogeneous Focusing Media Part III: Wall Effects, Losses, and the Transition from Fast to Slow Waves." 1969 Transactions on Microwave Theory and Techniques 17.7 (Jul. 1969 [T-MTT]): 360-363.

This paper is concerned with the determination of field patterns, propagation constants, and losses for axially propagating modes guided by an enclosed circular cylindrical, radially inhomogeneous dielectric of the type discussed in Parts I and II. The homogeneous outer medium (gamma >= a) is assumed to have a large relative permittivity epsilon/sub 2/, and the analysis includes the perfect conductor case epsilon/sub 2/ --> /spl infin/. The transition to trapped waves as the binding effect increases is demonstrated. Propagation constants in the case with loss are determined using a perturbation technique.

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Abstracts

Circuit Model Simulation of Gunn Effect Devices

N.R. Mantena and M.L. Wright. "Circuit Model Simulation of Gunn Effect Devices." 1969 Transactions on Microwave Theory and Techniques 17.7 (Jul. 1969 [T-MTT]): 363-373.

A circuit model of the Gunn device that retains both the time dependent and nonlinear device properties is presented. The model is based on the physical properties of a high-field domain in a uniformly doped sample and represents this domain and the remainder of the device by appropriate circuit elements. A computer program has been written that allows the device to be connected to any combination of RLC elements up to and including two parallel RLC circuits in series. Computer calculations have been made with a low resistance series circuit to simulate the Gunn mode of operation. The variation of Gunn frequency with bias voltage has been calculated and is in qualitative agreement with experiments. An inductance of 1 nH in series with 1 ohm is found to significantly alter results in comparison with the pure resistive case. The effect of this series inductance has also been observed experimentally as a lack of harmonics in resistive device mounts with stray inductance. Results obtained with a parallel RLC circuit point out the importance of circuit voltage control on the domain behavior. The LSA diode is treated as a bulk conductance following the drift velocity-electric field curve for GaAs. The bulk velocity and differential mobility are approximated by polynomials of electric field from which the device equivalent circuit is obtained. A physical insight into the operation of the LSA device is gained through a plot of time-integrated differential mobility with time. It is shown that an RF load for which this integral does not change appreciably over an RF period results in maximum efficiency. Results of efficiency and negative resistance of the device obtained for a bias field of 10 kV/cm are presented and are in good agreement with calculations of other workers.

Abstracts

Propagation and Scattering in Radially Flowing Media

D. Censor. "Propagation and Scattering in Radially Flowing Media." 1969 Transactions on Microwave Theory and Techniques 17.7 (Jul. 1969 [T-MTT]): 374-378.

The first-order (in v/c) vector wave equation for electromagnetic waves in moving media is solved for radially moving media. Two modes of flow are considered, the two-dimensional case of media flowing radially, symmetrically with respect to the z axis, and the three-dimensional case where the flow is symmetrical with respect to the origin. It is shown that the solution differs from the case of media at rest by a scalar multiplicative factor, involving the radius and the velocity. Propagation of a plane wave is discussed, and the local behavior is interpreted in terms of a ray propagating in the moving medium. It is shown that for an outgoing flow, the ray moves away from the origin in the finite domain. At large distances the ray enters and emerges from the medium in the same direction. Scattering by a cylinder and by a sphere, symmetrical with respect to the two-, and three-dimensional flow, respectively, are discussed. It is shown that the scattering amplitude is velocity-independent. This result is contrasted with former cases of scattering in moving media.

Abstracts

Exact Solutions of Stepped Impedance Transformers Having Maximally Flat and Chebyshev Characteristics

C.S. Gledhill and A.M.H. Issa. "Exact Solutions of Stepped Impedance Transformers Having Maximally Flat and Chebyshev Characteristics." 1969 Transactions on Microwave Theory and Techniques 17.7 (Jul. 1969 [T-MTT]): 379-386.

An exact method, involving the line vector z, is developed for calculating the characteristic impedances of stepped impedance transformers having maximally-flat and Chebyshev characteristics. It is also shown that this leads to considerable economy of effort compared with earlier methods.

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On Stored Energy and Bandwidth in TEM-Mode Microwave Networks

G.F. Ross. "On Stored Energy and Bandwidth in TEM-Mode Microwave Networks." 1969 Transactions on Microwave Theory and Techniques 17.7 (Jul. 1969 [T-MTT]): 386-395.

From time domain considerations, a method is presented to calculate the energy stored in certain resonant TEM-mode microwave networks. The time average of the stored energy is then used to define an instantaneous signal bandwidth parameter through the definition of a Q or quality factor. It is demonstrated by experiment that the Q factor is inversely proportional to the rise time of the envelope of the step-modulated response of the network at resonance.

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A Two-Channel Off-Null Technique for Measuring Small Changes of Attenuation (Correspondence)

T. Nemoto, R.W. Beatty and G.H. Fentress. "A Two-Channel Off-Null Technique for Measuring Small Changes of Attenuation (Correspondence)." 1969 Transactions on Microwave Theory and Techniques 17.7 (Jul. 1969 [T-MTT]): 396-397.

A technique is described for measuring small changes of attenuation that are not accompanied by significant changes in phase shift. It is a two-channel technique in which a small off-null output signal undergoes relatively large changes when small changes are made in a test attenuator in one of the channels. The procedure is described and measurements from 0.01 to 0.1 dB on a rotary vane attenuator are compared with similar measurements by a different method. Agreement is within 4 percent.

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The Design of Waveguides with Symmetrically Placed Double Ridges (Correspondence)

E.V. Jull, W.J. Bleackley and M.M. Steen. "The Design of Waveguides with Symmetrically Placed Double Ridges (Correspondence)." 1969 Transactions on Microwave Theory and Techniques 17.7 (Jul. 1969 [T-MTT]): 397-399.

Design curves for TE-mode propagation in a rectangular waveguide with double ridges placed symmetrically about the guide axis are presented. The waveguide is potentially very useful in microwave beating and drying applications.

Abstracts

On High-Pass Transmission-Line Directional Couplers (Correspondence)

S.C. Dutta Roy. "On High-Pass Transmission-Line Directional Couplers (Correspondence)." 1969 Transactions on Microwave Theory and Techniques 17.7 (Jul. 1969 [T-MTT]): 400-400.

It is shown that in a loosely coupled transmission line directional coupler, a continuously tapered coupling factor having a nonzero finite value everywhere along the longitudinal direction and having continuous derivatives gives high-pass coupling with approximately equal ripple characteristic at high values of frequency. The exponential and cosine types of nonuniformities are considered as examples to illustrate the theory.

Abstracts

Use of Symmetry in the Variational Treatment of a Magnetoplasma-Filled Waveguide (Correspondence)

K.S. Champlin. "Use of Symmetry in the Variational Treatment of a Magnetoplasma-Filled Waveguide (Correspondence)." 1969 Transactions on Microwave Theory and Techniques 17.7 (Jul. 1969 [T-MTT]): 401-401.

A variational expression for the propagation coefficients of the normal modes of an axially magnetized plasma-filled waveguide is formulated in terms of waveguide symmetry. This new expression is shown to be more useful than expressions derived previously.

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Wave Reflections from Rotary-Vane Attenuators (Correspondence)

M.H. Rahman and M.W. Gunn. "Wave Reflections from Rotary-Vane Attenuators (Correspondence)." 1969 Transactions on Microwave Theory and Techniques 17.7 (Jul. 1969 [T-MTT]): 402-403.

A method is described for the correction of the measurement error in a microwave reflection bridge circuit which arises from the scattering coefficients at the input ports of the rotary-vane precision attenuator standard component.

Abstracts

Equivalent Circuit of the Bolometer Detector (Comment)

J.J. Whalen and C.R. Westgate. "Equivalent Circuit of the Bolometer Detector (Comment)." 1969 Transactions on Microwave Theory and Techniques 17.7 (Jul. 1969 [T-MTT]): 403-404.

Equivalent circuits for both positive and negative temperature coefficient bolometers are reviewed. These circuits may be used to obtain either the responsivity and response time of a bolometer detector or the conversion loss and response time of a bolometer mixer. The application of these circuits to the bulk inidium antimonide detector and mixer is discussed.

Abstracts

3 lambda /sub 0/ /4 Parallel-Staggered Microwave Filters (Correspondence)

R.M. Davis. "3 lambda /sub 0/ /4 Parallel-Staggered Microwave Filters (Correspondence)." 1969 Transactions on Microwave Theory and Techniques 17.7 (Jul. 1969 [T-MTT]): 404-406.

A new microwave bandpass filter is described. Near the passband this filter has the electrical characteristics of an interdigital filter but requires no short circuits. The filter is compact and well suited for stripline construction.

Abstracts

A More General N-Way Hybrid Power Divider (Correspondence)

J.J. Taub and G.P. Kurpis. "A More General N-Way Hybrid Power Divider (Correspondence)." 1969 Transactions on Microwave Theory and Techniques 17.7 (Jul. 1969 [T-MTT]): 406-408.

The purpose of this note is to describe and give the theoretical performance of a hybrid power divider (or combiner) network that is a more general version of one described by Wilkinson. Fig. 1 shows the general circuit under consideration. Wilkinson's network is the special case of the generator resistance (R/sub 0/) equal to the load resistance (R/sub 0/).

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Contributors (Jul. 1969 [T-MTT])

D. Censor, M.A. Gerdine, C.S. Gledhill, A.M.H. Issa, C.N. Kurtz, N.R. Mantena, G.F. Ross, W. Streifer and M.L. Wright. "Contributors (Jul. 1969 [T-MTT])." 1969 Transactions on Microwave Theory and Techniques 17.7 (Jul. 1969 [T-MTT]): 409-410.

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Editorial Comment (Aug. 1969 [T-MTT])

G.I. Haddad. "Editorial Comment (Aug. 1969 [T-MTT])." 1969 Transactions on Microwave Theory and Techniques 17.8 (Aug. 1969 [T-MTT] (Special Issue on Computer-Oriented Microwave Practices)): 414-414.

The computer has played a very important role in the development of microwave circuit design. This role will continue to expand in the future at a very rapid rate. Several important contributions have already been made in this area as evidenced by the articles in this issue of the G-MTT Transactions and several important contributions will be forthcoming. It is hoped that this special issue of the Transactions will help bring to the attention of the microwave engineer the expanding role of the computer in solving his design problems and how the solution of these problems can be made simpler and more exact.

Abstracts

Introduction (Aug. 1969 [T-MTT])

W.J. Getsinger. "Introduction (Aug. 1969 [T-MTT])." 1969 Transactions on Microwave Theory and Techniques 17.8 (Aug. 1969 [T-MTT] (Special Issue on Computer-Oriented Microwave Practices)): 415-415.

As Guest Editor of this computer-oriented special issue of the IEEE Transactions on Microwave Theory and Techniques, I've had a wide view of computer-oriented microwave engineering of 1968-69. In a very general way, here's how it looks to me now. Within microwaves, electromagnetic field analysts seem to be the group most fully converted to the computer. They have been reevaluating classical techniques and developing new techniques to solve boundary value problems by numerical methods. Problems which formerly could be solved only conceptually, or by excessive commitment of hand calculation, are now done in a few minutes or even seconds of machine time.

Abstracts

Computation of Electromagnetic Fields

A. Wexler. "Computation of Electromagnetic Fields." 1969 Transactions on Microwave Theory and Techniques 17.8 (Aug. 1969 [T-MTT] (Special Issue on Computer-Oriented Microwave Practices)): 416-439.

This paper reviews some of the more useful, current and newly developing methods for the solution of electromagnetic fields. It begins with an introduction to numerical methods in general, including specific references to the mathematical tools required for field analysis, e.g., solution of systems of simultaneous linear equations by direct and iterative means, the matrix eigenvalue problem, finite difference differentiation and integration, error estimates, and common types of boundary conditions. This is followed by a description of finite difference solution of boundary and initial value problems. The paper reviews the mathematical principles behind variational methods, from the Hilbert space point of view, for both eigenvalue and deterministic problems. The significance of natural boundary conditions is pointed out. The Rayleigh-Ritz approach for determining the minimizing sequence is explained, followed by a brief description of the finite element method. The paper concludes with an introduction to the techniques and importance of hybrid computation.

Abstracts

Computation of Approximate Polynomial Solutions to TE Modes in an Arbitrarily Shaped Waveguide

R.M. Bulley and J.B. Davies. "Computation of Approximate Polynomial Solutions to TE Modes in an Arbitrarily Shaped Waveguide." 1969 Transactions on Microwave Theory and Techniques 17.8 (Aug. 1969 [T-MTT] (Special Issue on Computer-Oriented Microwave Practices)): 440-446.

Computer programs have been developed to investigate the construction of polynomial approximations to H-modes in empty guide of arbitrary shape. Mathematically this corresponds to the approximate solution of the Helmholtz equation with homogeneous Neumann boundary conditions. The method used is the well-known Rayleigh-Ritz. Both polynomial and piecewise polynomial function spaces have been investigated for several types of waveguide cross section. Particularly good results have been obtained for convexguides.A comprehensive set of H-mode contour plots are presented for four well-known guide sections.

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Abstracts

Functional Approximations for Solving Boundary Value Problems by Computer

D.T. Thomas. "Functional Approximations for Solving Boundary Value Problems by Computer." 1969 Transactions on Microwave Theory and Techniques 17.8 (Aug. 1969 [T-MTT] (Special Issue on Computer-Oriented Microwave Practices)): 447-454.

The use of functional (as opposed to numerical) approximations in solving electromagnetic boundary value problems is presented. Galerkin's method is modified to simplify the choice of trial functions by permitting use of trial functions which do not satisfy certain boundary conditions. A test problem, the dielectric loaded rectangular waveguide, is worked using both the modified and unmodified Galerkin's method with identical results. This method is then applied to the arbitrary waveguide. The cutoff frequencies and computer drawn contour plots are presented for circular, rectangular, triangular and star-shaped waveguides.

Abstracts

A Computer Optimization of the Rayleigh-Ritz Method

A.S. Vander Vorst, A.A. Laloux and R.J.M. Govaerts. "A Computer Optimization of the Rayleigh-Ritz Method." 1969 Transactions on Microwave Theory and Techniques 17.8 (Aug. 1969 [T-MTT] (Special Issue on Computer-Oriented Microwave Practices)): 454-460.

A method has been developed to improve the use of the Rayleigh-Ritz procedure. A criterion is established, which is a measure of the cumulative improvement due to the addition of more and more terms in the series expansion. Without calculating the exact roots of determinantal equations, the convergence is accelerated by skipping unnecessary intermediate steps. The computation time is drastically reduced because the final result is obtained after only a few (not more than 5 to 7) values of determinants of increasing order. Inhomogeneneously loaded waveguides are chosen as an application because the exact solution is available to check the validity of the method. The results obtained with the method described in this paper are compared with other approximate procedures. The comparison shows a definite advantage for the suggested technique.

Abstracts

Iterative Solutions of the Scalar Helmholtz Equation in Lossy Regions

J.R. Molberg and D.K. Reynolds. "Iterative Solutions of the Scalar Helmholtz Equation in Lossy Regions." 1969 Transactions on Microwave Theory and Techniques 17.8 (Aug. 1969 [T-MTT] (Special Issue on Computer-Oriented Microwave Practices)): 460-464.

Iterative solutions to the finite difference equations derived from the scalar Helmholtz equation are found to diverge for domains greater than a certain size. A transform method is presented which produces convergence in larger domains. The method is illustrated by solutions for one- and two-dimensional cases involving lossy dielectric media.

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Abstracts

The Finite Difference Solution of Microwave Circuit Problems

D.H. Sinnott, G.K. Cambrell, C.T. Carson and H.E. Green. "The Finite Difference Solution of Microwave Circuit Problems." 1969 Transactions on Microwave Theory and Techniques 17.8 (Aug. 1969 [T-MTT] (Special Issue on Computer-Oriented Microwave Practices)): 464-478.

Using finite difference methods this paper shows how solutions may be obtained with the aid of a digital machine to a wide range of microwave circuit problems. These problems include the parameters of TEM-mode transrnission lines, the equivalent circuits of obstacles in these lines, the cutoff frequencies of the fundamental mode in a waveguide of very general cross section, and the equivalent circuits of obstacles in rectangular waveguide. Methods for deriving the appropriate finite difference equations are presented and optimum methods for their solution set out; singularities are also included in the treatment. The paper ends with a resume of some typical results to problems of practical interest which have been obtained by these methods.

Abstracts

Accurate Impedance Determination of Coupled TEM Conductors

R.R. Gupta. "Accurate Impedance Determination of Coupled TEM Conductors." 1969 Transactions on Microwave Theory and Techniques 17.8 (Aug. 1969 [T-MTT] (Special Issue on Computer-Oriented Microwave Practices)): 479-489.

A computer-aided finite-difference method is described which can be used to calculate accurately TEM mode impedances of a uniform pair of offset parallel-coupled conductors of arbitrary cross section. The calculated impedance is the average of the lower and upper bounds computed on the mode impedance. For a given computing time, the average impedance is usually found to be more accurate than the one obtainable with either bound alone. The use of a graded mesh is found to provide a smaller separation between the bounds, and hence a smaller maximum error in the average impedance value, in a time much shorter than with the uniform mesh.

Abstracts

Analysis of Coaxial Line Discontinuities by Boundary Relaxation

P. Silvester and I.A. Cermak. "Analysis of Coaxial Line Discontinuities by Boundary Relaxation." 1969 Transactions on Microwave Theory and Techniques 17.8 (Aug. 1969 [T-MTT] (Special Issue on Computer-Oriented Microwave Practices)): 489-495.

Discontinuities in coaxial lines may in general be represented in equivalent networks by lumped capacitances. The calculation of discontinuity capacitance is possible by means of mode-matching techniques for very simple discontinuities; for more complex cases, direct numerical methods are preferable. A new numerical technique is presented for solving the field problem in a region bounded on two sides by infinitely extending coaxial lines. The approach used is to define operators by means of which the potentials at a given cross-sectional plane of the coaxial line are related to potentials at another plane. The problem of a discontinuity region between two infinitely long lines is thereby converted into a finite problem with prescribed boundary operators in place of boundary values. Standard methods may be used to solve the problem in a finite region. Subsequent reformulation of the discontinuity capacitance in terms of stored energy permits calculation of this capacitance from the potential values in only a minimal region. The resulting computer programs are at least an order of magnitude faster than previously published ones.

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DIPNET: A General Distributed Parameter Network Analysis Program

W.N. Parker. "DIPNET: A General Distributed Parameter Network Analysis Program." 1969 Transactions on Microwave Theory and Techniques 17.8 (Aug. 1969 [T-MTT] (Special Issue on Computer-Oriented Microwave Practices)): 495-505.

The DIPNETcomputer program makes practical the simple and rapid solution of elaborate microwave networks on a time-sharing computer. Given a file of input data describing a DIstributed Parameter NET-work of electrical sections, the program finds the complex voltage and current phasors along the network over a prescribed range of frequencies. Sections may consist of a variety of transmission lines, lumped constants, sources, and active devices. Network configurations may include chains, side stubs, and two-path sections. The network size is practically unlimited, and may easily comprise hundreds of sections. Output data at selected points along the network may include phasors, their absolute magnitude and phase shift, and power flow. Normalization to designated phasors is provided for by the program. The output data may also include input resistance, reactance, impedance, and the admittance counterparts. Repeated sequences may be handled automatically. Network parameters may also be modified automatically, both those which depend on frequency and frequency-independent parameters.

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General Purpose Programs for the Frequency Domain Analysis of Microwave Circuits

P.E. Green. "General Purpose Programs for the Frequency Domain Analysis of Microwave Circuits." 1969 Transactions on Microwave Theory and Techniques 17.8 (Aug. 1969 [T-MTT] (Special Issue on Computer-Oriented Microwave Practices)): 506-514.

This paper describes microwave circuit analysis programs techniques for general purpose which perform frequency domain analyses. Differing techniques used in two programs are described. The first uses transfer matrix analysis and is limited to networks having tree structured topologies and two-port devices such as transmission lines, stubs and lumped elements. It runs on a time-shared computer and is used for interactive design. The second program can analyze any linear network including those with multiport elements such as coupled transmission lines. This uses a nodal representation for the circuit and relies on inverting an admittance matrix to perform the analysis. In the first program the user describes his circuit in terms of topology as well as circuit elements. By this technique, a considerable reduction in computer size needed to run this program is effected. A 60 element circuit can be run on a commercial time-sharing service with less than 6K words of available core. The second program requires a large computer; for example, 32K words or core storage are required to analyze a 50 node circuit.

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Microwave Circuit Design by Digital Computer

M.A. Murray-Lasso and E.B. Kozemchak. "Microwave Circuit Design by Digital Computer." 1969 Transactions on Microwave Theory and Techniques 17.8 (Aug. 1969 [T-MTT] (Special Issue on Computer-Oriented Microwave Practices)): 514-526.

Methods for the automatic analysis and design of microwave circuits using a digital computer in batch mode are given. The methods are capable of handling microwave components modeled by ordinary R, L, C, M, CS elements pins transmission lines and multiterminal black-boxes whose characteristics have been determined theoretically or experimentally. The analysis-optimization program, IMPROVE (Integrated and Microwave PRogram for Optimizing Variable Elements), implementing the methods presented in this paper is described and its use illustrated with a practical design problem.

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Automatic General-Purpose Microwave Circuit Analysis Programs (Panel Discussion)

P.E. Green, M.K. McPhun, M.A. Murray-Lasso and A.E. Smoll. "Automatic General-Purpose Microwave Circuit Analysis Programs (Panel Discussion)." 1969 Transactions on Microwave Theory and Techniques 17.8 (Aug. 1969 [T-MTT] (Special Issue on Computer-Oriented Microwave Practices)): 527-533.

The panel members were asked to respond to the Editor's question, given below. They were then given copies of each others comments, and asked to respond with a second-round of opinions.

Abstracts

Optimization Methods for Computer-Aided Design

J.W. Bandler. "Optimization Methods for Computer-Aided Design." 1969 Transactions on Microwave Theory and Techniques 17.8 (Aug. 1969 [T-MTT] (Special Issue on Computer-Oriented Microwave Practices)): 533-552.

This paper surveys record automatic optimization methods which either have found or should find useful application in the optimal design of microwave networks by digital computer. Emphasis is given to formulations and methods which can be implemented in situations when the classical synthesis approach (analytic or numerical) is inappropriate. Objectives for network optimization are formulated including minimax and least pth. Detailed consideration is given to methods of dealing with parameter and response constraints by means of transformations or penalties. In particular, the formulation of problems in terms of inequality constraints and their solution by sequential unconstrained minimization is discussed. Several one-dimensional and multidimensional minimization strategies are summarized in a tutorial manner. Included are Fibonacci and Golden Section search, interpolation methods, pattern search, Rosenbrock's method, Powell's method, simplex methods, and the Newton-Raphson, Fletcher-Powell, and least squares methods. Relevant examples of interest to microwave circuit designers illustrating the application of computer-aided optimization techniques are presented. The paper also includes a classified list of references.

Abstracts

Optimization of Microwave Networks by Razor Search (Aug. 1969 [T-MTT])

J.W. Bandler and P.A. Macdonald. "Optimization of Microwave Networks by Razor Search (Aug. 1969 [T-MTT])." 1969 Transactions on Microwave Theory and Techniques 17.8 (Aug. 1969 [T-MTT] (Special Issue on Computer-Oriented Microwave Practices)): 552-562.

A new optimization method called razor search is presented. The method, which is based on pattern search, was specifically developed for the automatic optimization by computer of networks for which the objective is to minimize the maximum deviation of some response from a desired ideal response specification. Minimax response objectives, which can lead to equal-ripple optima, will in general give rise to discontinuous partial derivatives of the objective function with respect to the network parameters. Otherwise efficient optimization methods may slow down or even fail to reach an optimum in such circumstances, particularly when the response hypersurface has a narrow curved valley along which the path of discontinuous derivatives lies. Another direct search method called ripple search is also presented. This method was developed to locate the extrema of multimodal functions of one variable in an efficient manner, and is used to determine the maximum deviation of the response from the desired response. Sufficiently detailed flow diagrams are available so that the methods can be readily programmed. The razor search strategy (with ripple search) has been successfully applied to the optimization of inhomogeneous waveguide transformers. It is illustrated in this paper by examples of cascaded commensurate and noncoummensurate transmission lines acting as impedance transformers for which the optima are known.

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Computer Optimization of Inhomogeneous Waveguide Transformers

J.W. Bandler. "Computer Optimization of Inhomogeneous Waveguide Transformers." 1969 Transactions on Microwave Theory and Techniques 17.8 (Aug. 1969 [T-MTT] (Special Issue on Computer-Oriented Microwave Practices)): 563-571.

The problem of designing broadband multisection stepped rectangular waveguide impedance transformers, when the input and output guides have different cutoff frequencies but propagate the same mode, is formulated in general terms for direct optimization by digital computer. The formulation is sufficiently flexible to allow nonideal junction discontinuity effects and mismatched terminations to be taken into account during optimization. Constraints placed on the width, height, or length of any section need be dictated only by considerations for dominant mode propagation and the requirement of small (but not necessarily negligible) junction discontinuities. The objective of the present formulation is a minimax equal-ripple response over a predetermined frequency band satisfying the constraints selected for the particular problem. The ripple search strategy to locate the maximum reflection coefficient within the band and the razor search strategy to minimize it, as described by Bandler and Macdonald in another paper, were employed. Constrained optimum equal-ripple solutions to examples previously published by Young, Matthaei et al. and Riblet are presented. They demonstrate the considerable improvements made possible by the present formulation with regard to performance, reduction in number of sections, and physical size. The approach used in this paper should also find application in the design of broadband microwave matching or equalizing networks consisting of noncommensurate components and for which exact synthesis techniques may be unavailable.

Abstracts

Computer-Aided Microwave Impedance Measurements (Aug. 1969 [T-MTT])

J.E. Dalley. "Computer-Aided Microwave Impedance Measurements (Aug. 1969 [T-MTT])." 1969 Transactions on Microwave Theory and Techniques 17.8 (Aug. 1969 [T-MTT] (Special Issue on Computer-Oriented Microwave Practices)): 572-576.

The use of a general purpose digital computer to convert data obtained from a network analyzer system to parameters useful to the circuit or device engineer is discussed. Measurement errors resulting from system imperfections such as coupler directivity and reflections from small discontinuities are removed by matrix manipulation while the data are being processed. The computer program was written to allow any three known impedances to be used as references. The use of arbitrary reference impedances instead of ideal short circuits, ideal open circuits, or perfectly matched terminations allows greater flexibility and in most cases permits the system to be calibrated with only three measurements at each frequency. Quantitative results are presented which show the large reduction of the error vector obtained when measurements are corrected using the method described. The corrected results are compared with the manufacturer's calibration data for some loads. All measurements are compared with measurements made on a recently marketed automatic network analyzer system. The computer program was written to allow the use of a time-sharing remote-access computer for fast turn-around time for small amounts of data. A second program was written for use with batch-process computers when large amounts of data are needed.

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Abstracts

The Design of Discrete N-Section and Continuously Tapered Symmetrical Microwave TEM Directional Couplers

D.W. Kammler. "The Design of Discrete N-Section and Continuously Tapered Symmetrical Microwave TEM Directional Couplers." 1969 Transactions on Microwave Theory and Techniques 17.8 (Aug. 1969 [T-MTT] (Special Issue on Computer-Oriented Microwave Practices)): 577-590.

A method is presented for the computer-aided design of either N-section discrete or continuously tapered symmetrical microwave couplers. The coupling distribution function k(x) is parametrized in the form k(x, p/spl ovbr/), and a special optimization process (of the generalized Remez type) is used to determine the set of parameters p/spl ovbr/ which produce an optimum power coupling response. Standard parametric forms based on an approximate Fourier analysis as well as more general spline parametric forms for k(x, p/spl ovbr/) are developed and illustrated.

Abstracts

Dominant Pole Synthesis of Transmission Line Networks (Aug. 1969 [T-MTT])

S. Mahdi and A.B. Macnee. "Dominant Pole Synthesis of Transmission Line Networks (Aug. 1969 [T-MTT])." 1969 Transactions on Microwave Theory and Techniques 17.8 (Aug. 1969 [T-MTT] (Special Issue on Computer-Oriented Microwave Practices)): 591-597.

This paper describes a procedure for synthesizing transmission networks which are interconnections of uniform line elements. An iterative, digital computer algorithm is developed which achieves a dominant pole synthesis. The line lengths and the characteristic impedances are controlled individually, which gives design flexibility not found in synthesis procedures based on Richards' transformation. Thus, the characteristic impedances may be restricted by upper and lower bounds when there is no restriction on the line lengths. The procedure is detailed for a TEM mode structure of alternating open stubs and connecting lines. The method uses a Newton-Raphson iterative scheme to adjust the characteristic impedances and lengths of the transmission lines for a prescribed set of dominant transmission poles. By controlling the stub line lengths and the dominant pole positions, the principal transmission zeros and bounded characteristic impedances can be achieved simultaneously.

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Computer Design of Filters with Lumped-Distributed Elements or Frequency Variable Terminations

H.J. Carlin and O.P. Gupta. "Computer Design of Filters with Lumped-Distributed Elements or Frequency Variable Terminations." 1969 Transactions on Microwave Theory and Techniques 17.8 (Aug. 1969 [T-MTT] (Special Issue on Computer-Oriented Microwave Practices)): 598-604.

A method for realizing prescribed insertion loss characteristics is presented which is applicable to mixed distributed lumped parameter systems, as well as to transmission line structures which operate into resistive frequency variable terminations. The method utilizes scattering matrix renormalization and is implemented by a computer program. Examples given include capacitor and inductor loaded transmission line sections, as well as a TEM filter terminated in TE/sub 10/ wave impedances. The insertion loss characteristics have equal ripple passband behavior.

Abstracts

Optimal Synthesis of Distributed Parameter Systems

A.R. Karnik and G.H. Cohen. "Optimal Synthesis of Distributed Parameter Systems." 1969 Transactions on Microwave Theory and Techniques 17.8 (Aug. 1969 [T-MTT] (Special Issue on Computer-Oriented Microwave Practices)): 605-611.

A technique is developed for the synthesis and design of a distributed parameter system guiding waves from one point in space to another. The parameter distributions are assumed to be nonrestricted except for the upper and lower bounds resulting from the imposition of physical realizability. The problem is similar to the "sensitivity" problem encountered in the optimal control of the systems. An improved version of the first-order gradient technique is used to obtain the optimal distributions of the parameters. The first-order gradient technique is sensitive to the form of the arbitrary distributions assumed at the start of the iterations. This technique has serious convergence problems associated with it. The problem is particularly severe and is encountered in "singular" optimal control problems. The algorithm devised here improves the first-order gradient technique so that it becomes less sensitive to the initial assumed distributions and virtually eliminates the convergence problems generated because of the bounds on the parameter distributions. A transmission line with distributed series r, l and shunt c is a particular case of the distributed parameter system. The optimal design of a notched filter employing a thin film circuit is a successful example of the application of the improved gradient technique. These distributions have been obtained by the use of a hybrid computer.

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Abstracts

Computer-Aided Design of Broad-Band and Low-Noise Microwave Amplifiers

T.W. Houston and L.W. Read. "Computer-Aided Design of Broad-Band and Low-Noise Microwave Amplifiers." 1969 Transactions on Microwave Theory and Techniques 17.8 (Aug. 1969 [T-MTT] (Special Issue on Computer-Oriented Microwave Practices)): 612-614.

We have found iterative optimization techniques to be very effective in the design of broad-band low-noise integrated amplifiers. This paper presents an objective function to maximize gain while minimizing ripple and noise figure. An optimization routine using this objective function is applied to the design of an L-band amplifier. The results of several runs using different objectives applied to the same circuit topology are presented to demonstrate both the flexibility of this technique and the tradeoffs involved. One of the designs was fabricated, and the measured and predicted performance agree closely over an octave bandwidth.

Abstracts

Computerized Calculation of Small Signal and Noise Properties of Microwave Transistors

W. Baechtold, W. Kotyczka and M.J.O. Strutt. "Computerized Calculation of Small Signal and Noise Properties of Microwave Transistors." 1969 Transactions on Microwave Theory and Techniques 17.8 (Aug. 1969 [T-MTT] (Special Issue on Computer-Oriented Microwave Practices)): 614-619.

The small signal and noise equivalent circuit of a microwave transistor is evaluated using an analog simulation model. The noise figure has been determined with the same model as a function of the source admittance and the frequency. The s parameters and noise figures are compared with the results calculated on a digital computer.

Abstracts

ECAP Analysis of UHF-Transistor-Oscillator Transient Response

H.-N. Toussaint. "ECAP Analysis of UHF-Transistor-Oscillator Transient Response." 1969 Transactions on Microwave Theory and Techniques 17.8 (Aug. 1969 [T-MTT] (Special Issue on Computer-Oriented Microwave Practices)): 620-626.

The oscillation amplitude of an octave band tunable power oscillator is calculated from the transient response of the oscillator at the frequencies of 250 MHz and 500 MHz. The oscillator circuit is at first simplified in order to save computing time. By use of a modified Ebers-Moll-transistor equivalent circuit the simplified circuit is transformed into a network of 62 branches and 26 nodes which is accessible to ECAP-computation. The calculated values coincide almost completely with the measured values.

Abstracts

A Computer-Aided Design of a Microwave Delay Equalizer

P.J. Tu. "A Computer-Aided Design of a Microwave Delay Equalizer." 1969 Transactions on Microwave Theory and Techniques 17.8 (Aug. 1969 [T-MTT] (Special Issue on Computer-Oriented Microwave Practices)): 626-634.

The folded-tape meander-line configuration that has been used in the design of compression filters for chirp radar applications can also be used in the design of microwave delay equalizers for communication systems. Specifically, it can be utilized in the design of delay equalizers for use in the repeaters of a long distance waveguide transmission system. In this paper, the synthesis of such L-band delay equalizers using a general purpose successive approximation computer program, SUPROX is described. In this procedure, both the locations of the resonant frequencies and the number of meander-line turns at each of these resonant frequencies are optimized to give the final design. Linear as well as certain higher order delay characteristics have been synthesized with a high degree of accuracy. Experimental results show excellent agreement with the theoretical designs.

Abstracts

Calculation of TEM Transmission-Line Parameters by Finite-Difference Computation of Electric Flux (Correspondence)

D.H. Sinnott. "Calculation of TEM Transmission-Line Parameters by Finite-Difference Computation of Electric Flux (Correspondence)." 1969 Transactions on Microwave Theory and Techniques 17.8 (Aug. 1969 [T-MTT] (Special Issue on Computer-Oriented Microwave Practices)): 634-637.

Parameters of TEM-mode transmission lines may be calculated by using a finite difference potential solution over the cross section to compute electric flux across a contour and by applying Gauss' theorem. It is shown that an alternative electrostatic energy method gives the same result when the finite difference equations are exactly solved.

Abstracts

Fringing Capacitance Curves for Coplanar Rectangular Coupled Bars (Correspondence)

R.R. Gupta. "Fringing Capacitance Curves for Coplanar Rectangular Coupled Bars (Correspondence)." 1969 Transactions on Microwave Theory and Techniques 17.8 (Aug. 1969 [T-MTT] (Special Issue on Computer-Oriented Microwave Practices)): 637-638.

Even and odd mode fringing capacitance curves are presented, on an expanded scale, for tightly coupled coplanar rectangular bars between parallel ground planes. Accurate values of mode capacitances have been calculated by numerically solving the Laplace equation for the lower and upper bounds on the mode capacitance. The computed capacitance data presented is the average of the two bounds and is correct to within ± 1 percent of the exact data (before Plotting).

Abstracts

Design of Transmission-Line Dimensions for a Given Characteristic Impedance (Correspondence)

E. Yamashita and K. Atsuki. "Design of Transmission-Line Dimensions for a Given Characteristic Impedance (Correspondence)." 1969 Transactions on Microwave Theory and Techniques 17.8 (Aug. 1969 [T-MTT] (Special Issue on Computer-Oriented Microwave Practices)): 638-639.

The Newton-Raphson method is applied to the characteristic impedance formulas of strip transmission lines in such a way that the line dimensions can be directly calculated as the computer solution of a transcendental equation when the characteristic impedance is a given parameter.

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Reflection and Transmission of Electromagnetic Waves in Inhomogeneous Dielectric Filled Rectangular Waveguide (Correspondence)

T.W. Kao. "Reflection and Transmission of Electromagnetic Waves in Inhomogeneous Dielectric Filled Rectangular Waveguide (Correspondence)." 1969 Transactions on Microwave Theory and Techniques 17.8 (Aug. 1969 [T-MTT] (Special Issue on Computer-Oriented Microwave Practices)): 639-641.

The wave equation for the TE mode propagation in the rectangular waveguide containing longitudinally inhomogeneous dielectric is discussed. Using the technique of separation of variables, it is shown that the general waveguide solution for the transverse variables (x, y) still holds true. An approximate method is used to solve the z-variable ordinary differential equation. The relation of the Wronskian determinant of the solution and the accnracy of the solutions is discussed. Transmission and reflection of the electromagnetic wave by the inhomogeneous dielectric in the waveguide is formulated.

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Experimental Investigation with an Iris Beam Waveguide (Correction)

J.W. Mink. "Experimental Investigation with an Iris Beam Waveguide (Correction)." 1969 Transactions on Microwave Theory and Techniques 17.8 (Aug. 1969 [T-MTT] (Special Issue on Computer-Oriented Microwave Practices)): 641-641.

On page 49, (2) should have read:

Abstracts

Information on Computer Program Descriptions (Aug. 1969 [T-MTT])

J.W. Bandler. "Information on Computer Program Descriptions (Aug. 1969 [T-MTT])." 1969 Transactions on Microwave Theory and Techniques 17.8 (Aug. 1969 [T-MTT] (Special Issue on Computer-Oriented Microwave Practices)): 642-642.

This section of the Transactions on Microwave Theory and Techniques will carry descriptions of computer programs which have specific relevance to the microwave art, and are available to the microwave public. The purpose of Computer Program Descriptions is to provide a means by which microwave engineers may share useful computer programs with their colleagues. A Computer Program Description is in a separate class of technical publication, being neither a technical article nor a technical correspondence.

Abstracts

Synthesis of Distributed-Element Bandpass Filters (Program Descriptions)

A.K. Johnson. "Synthesis of Distributed-Element Bandpass Filters (Program Descriptions)." 1969 Transactions on Microwave Theory and Techniques 17.8 (Aug. 1969 [T-MTT] (Special Issue on Computer-Oriented Microwave Practices)): 643-643.

The program to be described is written in FORTRAN IV and has been successfully complied and run on the GE635 computer. Typical machine running time when operating on batch processing from a previously compiled deck is less than 25 seconds.

Abstracts

Program for Processing Standing Wave Measurements (Program Descriptions)

J.W. Bandler. "Program for Processing Standing Wave Measurements (Program Descriptions)." 1969 Transactions on Microwave Theory and Techniques 17.8 (Aug. 1969 [T-MTT] (Special Issue on Computer-Oriented Microwave Practices)): 644-645.

This subroutine processes standing wave measurements with or without line loss on a transrnission-line or waveguide load leading to its one-port characterization.

Abstracts

Response Program for an Inhomogeneous Cascade of Rectangular Waveguides (Program Descriptions)

J.W. Bandler and P.A. Macdonald. "Response Program for an Inhomogeneous Cascade of Rectangular Waveguides (Program Descriptions)." 1969 Transactions on Microwave Theory and Techniques 17.8 (Aug. 1969 [T-MTT] (Special Issue on Computer-Oriented Microwave Practices)): 646-649.

This package calculates the input admittance versus frequency to an arbitrarily terminated inhomogeneous cascade of rectangular waveguides with or without junction discontinuity effects.

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Computer Programs for Smith-Chart Solutions (Program Descriptions)

J.W. Verzino. "Computer Programs for Smith-Chart Solutions (Program Descriptions)." 1969 Transactions on Microwave Theory and Techniques 17.8 (Aug. 1969 [T-MTT] (Special Issue on Computer-Oriented Microwave Practices)): 649-650.

These subroutines are used in performing Smith-chart analysis. They are also applicable to even-odd mode analysis.

Abstracts

ZERO (Program Descriptions)

G. Oczkowski. "ZERO (Program Descriptions)." 1969 Transactions on Microwave Theory and Techniques 17.8 (Aug. 1969 [T-MTT] (Special Issue on Computer-Oriented Microwave Practices)): 650-650.

The program locates the zeros and poles of a complex valued function in a given region to a degree of accuracy specified by the user.

Abstracts

High-Order Finite Element Waveguide Analysis (Program Descriptions)

P. Silvester. "High-Order Finite Element Waveguide Analysis (Program Descriptions)." 1969 Transactions on Microwave Theory and Techniques 17.8 (Aug. 1969 [T-MTT] (Special Issue on Computer-Oriented Microwave Practices)): 651-652.

The program produces complete families of mode functions for homogeneous isotropic waveguides of polygonal shape with 25 or fewer sides.

Abstracts

Contour Plotting Routine for Line Printers (Program Descriptions)

I.A. Cermak, J.P. Legendre and P. Silvester. "Contour Plotting Routine for Line Printers (Program Descriptions)." 1969 Transactions on Microwave Theory and Techniques 17.8 (Aug. 1969 [T-MTT] (Special Issue on Computer-Oriented Microwave Practices)): 652-653.

Produces a contour map of a function defined over a rectangular grid. Linear interpolation between grid points is used to locate contours.

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Contributors (Aug. 1969 [T-MTT])

W. Baechtold, J.W. Bandler, R. Bulley, G.K. Cambrell, H.J. Carlin, C.T. Carson, I.A. Cermak, G.H. Cohen, J.E. Dalley, J.B. Davies, R.J.M. Govaerts, H.E. Green, P.E. Green, O.P. Gupta, R.R. Gupta, T.W. Houston, D.W. Kammler, A.R. Karnik, W. Kotyczka, E.B. Kozemchak, A.A. Laloux, P.A. Macdonald, A.B. Macnee, S. Mahdi, M.K. McPhun, J.R. Molberg, M.A. Murray-Lasso, W.N. Parker, L.W. Read, D.K. Reynolds, P. Silvester, D.H. Sinnott, A.E. Smoll, M.J.O. Strutt, D.T. Thomas, H.-N. Toussaint, P.J. Tu, A.S. Vander Vorst and A. Wexler. "Contributors (Aug. 1969 [T-MTT])." 1969 Transactions on Microwave Theory and Techniques 17.8 (Aug. 1969 [T-MTT] (Special Issue on Computer-Oriented Microwave Practices)): 653-658.

Abstracts

Microwave Abstracts (Aug. 1969 [T-MTT])

"Microwave Abstracts (Aug. 1969 [T-MTT])." 1969 Transactions on Microwave Theory and Techniques 17.8 (Aug. 1969 [T-MTT] (Special Issue on Computer-Oriented Microwave Practices)): 659-659.

Based on technical merit and timeliness, microwave papers in journals published outside the United States have been selected and compiled below, generally with brief abstracts. Reprints of the papers may be obtainable by writing directly to the author or to the source quoted.

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Information for Authors (Aug. 1969 [T-MTT])

"Information for Authors (Aug. 1969 [T-MTT])." 1969 Transactions on Microwave Theory and Techniques 17.8 (Aug. 1969 [T-MTT] (Special Issue on Computer-Oriented Microwave Practices)): 660-660.

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Table of Contents (Sep. 1969 [T-MTT])

"Table of Contents (Sep. 1969 [T-MTT])." 1969 Transactions on Microwave Theory and Techniques 17.9 (Sep. 1969 [T-MTT]): 661-661.

Abstracts

Active Filters for UHF and Microwave Frequencies

D.K. Adams and R.Y.C. Ho. "Active Filters for UHF and Microwave Frequencies." 1969 Transactions on Microwave Theory and Techniques 17.9 (Sep. 1969 [T-MTT]): 662-670.

A technique is described for using transistors directly as high-Q inductors at microwave frequencies. Several experimental band-pass filters have been built and tested to verify usefulness of the inductive transistor circuit. Stable filters with unity insertion loss have been realized at UHF. Observations made during temperature cycling show that environmental stabilization can also be achieved. Analysis has been made of noise figure and nonlinear distortion, and supporting experimental data are provided. The inductive transistor circuit is expected to be practical for a variety of small-signal filtering and multiplexing applications.

Abstracts

Ray-Optical Analysis of Electromagnetic Scattering in Waveguides

H.Y. Yee and L.B. Felsen. "Ray-Optical Analysis of Electromagnetic Scattering in Waveguides." 1969 Transactions on Microwave Theory and Techniques 17.9 (Sep. 1969 [T-MTT]): 671-683.

The ray-optical method presented previously for the analysis of scalarizable waveguide discontinuity problems is extended to vector scattering problems wherein an incident TE or TM mode excites both mode types. The procedure is illustrated first for reflection of an obliquely incident mode from the open end of a parallel plane waveguide, and is then applied to reflection from an open-ended circular waveguide. Formulas for modal reflection and coupling coefficients are given to various degrees of approximation, depending on whether or not multiple interaction phenomena are considered in addition to the simplest primary diffraction effects. Comparison with data computed from exact solutions for the circular waveguide problem shows that the ray-optical method is remarkably accurate not only in the strongly overmoded but also the dominant mode regimes.

Abstracts

Numerical Analysis of a Dielectric-Loaded Waveguide with a Microstrip Line-Finite-Difference Methods

J.S. Hornsby and A. Gopinath. "Numerical Analysis of a Dielectric-Loaded Waveguide with a Microstrip Line-Finite-Difference Methods." 1969 Transactions on Microwave Theory and Techniques 17.9 (Sep. 1969 [T-MTT]): 684-690.

A finite-difference technique is used to evaluate the dispersion of a dielectric-loaded waveguide with a symmetrically placed microstrip line. The magnetic field is also obtained. The results presented are for the fundamental even E/sub z/-odd H/sub z/ mode.

Abstracts

Computer-Aided Small-Signal Characterization of IMPATT Diodes (Sep. 1969 [T-MTT])

C.N. Dunn and J.E. Dalley. "Computer-Aided Small-Signal Characterization of IMPATT Diodes (Sep. 1969 [T-MTT])." 1969 Transactions on Microwave Theory and Techniques 17.9 (Sep. 1969 [T-MTT]): 691-695.

This paper is a discussion of IMPATT wafer small-signal characteristics in the frequency range of 2.0-8.0 GHz. These characteristics have been obtained by computer conversion of reflection phase-gain data. The data handling technique which allows establishment of the desired reference plane and the reduction of the admittance data into the desired equivalent circuit is presented. A calibration procedure using reference impedances consistent with the diode geometry is discussed. The validity of the microwave measurement technique and the data handling process is demonstrated by comparison of the values of junction capacitance determined at microwave frequencies with junction capacitance measurements at 30 MHz. Representative plots are given for wafer conductance and susceptance as a function of frequency with current density as a parameter. In addition, typical values obtained for the circuit elements are presented. These data illustrate the capability of determining package inductance, series resistance as a function of bias voltage, and, with the diode in avalanche, the parallel G, L, and C of the wafer admittance. The diode equivalent circuit was studied as a function of current density to compare results with the existing analytical small-signal theories. This procedure permits the separation of the wafer elements from the parasitic elements of the package. Data obtained from these measurements are extremely useful for ascertaining wafer design parameters and assisting in circuit design.

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Practical Strip-Line Microwave Circuit Design

G.L. Millican and R.C. Wales. "Practical Strip-Line Microwave Circuit Design." 1969 Transactions on Microwave Theory and Techniques 17.9 (Sep. 1969 [T-MTT]): 696-705.

It is widely recognized that continuously tapered strip-line components afford certain important advantages over their discrete counterparts in practical applications. (The question of coupler directivity, for instance, must come under close scrutiny as requirements become more severe in terms of frequency and bandwidth.) It is the purpose of this paper to set forth principles by which such components may be realized as a consequence of design techniques tailored to consistency with a given set of operational requirements applicable at once to an aggregate of different microwave strip-line components. In general, some or all of the components in such a group will differ in their nominal response characteristics. Derived through judicious application of constraints in an optimization procedure, the method obviates the need for intracircuit transformers or connectors transmission line cross section geometry compromises, component overdesign, etc., while at the same time providing mutual component compatibility and preservation of the quality of quasi-TEM microwave signal processing for a given specified bandwidth. By way of example, compatible multioctave designs have been established for components having nominal, equal-ripple responses differing by 1.7 dB. Corresponding conventional designs would have required impedance ratios of as much as 3.68:1 for a dielectric spacing such that s/b=1/9. Of particular concern are couplers with symmetric and nonsymmetric local coupling coefficient distributions and dispersive all-pass phase shift network elements. The general nonsymmetric coupler is realized without abrupt discontinuities at either end and with a constant specified unbalance phase (0</spl Phi//sub u/ <90) over the passband. Typical examples of experimental results are given.

Abstracts

A Strip-Line Directional Coupler Utilizing a Non-Homogeneous Dielectric Medium (Sep. 1969 [T-MTT])

J.E. Dalley. "A Strip-Line Directional Coupler Utilizing a Non-Homogeneous Dielectric Medium (Sep. 1969 [T-MTT])." 1969 Transactions on Microwave Theory and Techniques 17.9 (Sep. 1969 [T-MTT]): 706-712.

A 3 dB directional coupler which utilizes nonhomogeneous dielectric media to produce different phase velocities for the even and odd modes of propagation is described. The two output ports are conductively connected to each other as are the input and null ports with dc isolation between the input and both output ports. Well known thin-film techniques can be used to realize the coupler. General coupler equations and design parameters are given along with computer solutions and experimental verification. A minimum return loss of 22 dB was experimentally achieved over a 20 percent bandwidth and 27 dB minimum return loss with equal isolation over the same bandwidth is predicted with the application of simple compensation techniques. It is shown that the coupler maybe used to effect an impedance transformation between the input and output ports; however, the isolation is degraded.

Abstracts

A Temperature-Stable, Fail-Safe, Latching Ferrite TR Switch

W.W. Siekanowicz, D.J. Blattner, T.E. Walsh and R.W. Paglione. "A Temperature-Stable, Fail-Safe, Latching Ferrite TR Switch." 1969 Transactions on Microwave Theory and Techniques 17.9 (Sep. 1969 [T-MTT]): 712-717.

Use of transmitting-receiving (TR) ferrite switches in place of gas-discharge devices improves the noise figure, life, and reliability of radar receivers. This paper describes a TR ferrite switch that employs 180° differential-phase-shift toroids to provide essentially constant isolation and insertion loss over a wide temperature range, independence of isolation with respect to RF power, and full receiver protection in case of driver failure. The ferrite switch is functionally a transfer device that is reciprocal in terms of transmission-coefficient amplitudes but nonreciprocal with respect to transmission phases. An experimental C-band 180° ferrite switch has provided isolation ranging from 38 to 45 dB and an insertion loss of 0.4 dB across a -40°C to +75°C range and a peak power-handling capacity of 130 kW measured at 0.001 duty. The switching energy, not including driver losses, is approximately 150 µJ. The preceding values of isolation and insertion loss compare with 36 and 0.8 to 1.1 dB, respectively, across the above temperature range, for the combination of fixed circulator, limiter, and one switchable circulator.

Abstracts

Transmission Characteristics of a Reentrant Hybrid Tee (Correspondence) (Sep. 1969 [T-MTT])

T.K. Ishii and J.A. Jenners. "Transmission Characteristics of a Reentrant Hybrid Tee (Correspondence) (Sep. 1969 [T-MTT])." 1969 Transactions on Microwave Theory and Techniques 17.9 (Sep. 1969 [T-MTT]): 718-718.

Transmission through the collinear arms of a waveguide hybrid tee is symmetrical when its E and H arms are separated from each other. When the E and H arms are interconnected, and a reentrant loop is formed, the hybrid tee displays nonsymmetrical transmission properties.

Abstracts

Double Section Matching Transformers (Correspondence)

G.N. French and E.H. Fooks. "Double Section Matching Transformers (Correspondence)." 1969 Transactions on Microwave Theory and Techniques 17.9 (Sep. 1969 [T-MTT]): 719-719.

A method for the matching of a complex load impedance to the characteristic impedance of a transmission line is presented. The lengths of two transformer sections which have preselected characteristic impedances are determined from a Smith chart to give a compact matching structure which for many cases exhibits improved bandwidth properties over other techniques.

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Theoretical Expressions of Lumped Parameters in a Spheroidal Cavity (Correspondence)

E. Rivier. "Theoretical Expressions of Lumped Parameters in a Spheroidal Cavity (Correspondence)." 1969 Transactions on Microwave Theory and Techniques 17.9 (Sep. 1969 [T-MTT]): 720-720.

The so-called "spheroidal" cavity appears promising for coupling with solid-state elements of known equivalent circuit, such as GUM or Read diodes, because it is possible to find an equivalent circuit with lumped parameters for such a cavity. That circuit includes three parameters L/sub 0/, C/sub 0/, C/sub e/, with simple expressions.

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Abstracts

Group Delay Characteristics of a Nondegenerate Parametric Amplifier (Correspondence)

D. Chakraborty. "Group Delay Characteristics of a Nondegenerate Parametric Amplifier (Correspondence)." 1969 Transactions on Microwave Theory and Techniques 17.9 (Sep. 1969 [T-MTT]): 720-722.

The group delay characteristics of a C-band nondegenerate parametric amplifier have been determined experimentally by Nyquist's method. The accuracy of the results has been checked by an independent phase-of frequency derivative measurement. Higher order derivatives of the group delay function are also computed.

Abstracts

On the Scattering Parameters of a Reduced Multiport (Correspondence)

T.Y. Otoshi. "On the Scattering Parameters of a Reduced Multiport (Correspondence)." 1969 Transactions on Microwave Theory and Techniques 17.9 (Sep. 1969 [T-MTT]): 722-724.

A microwave receiving system often contains a multiport (such as a directional coupler, polarizer, or hybrid junction) that has been calibrated in the laboratory. The multi-port properties calibrated are usually the scattering parameters which are defined for matched load conditions. However, when the multiport is installed in the system, the terminations as seen looking out of the various ports are not generally matched.

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A Resonance Method for Measurement of Large Dielectric Constant with Small Loss (Correspondence)

J.-S. Yu. "A Resonance Method for Measurement of Large Dielectric Constant with Small Loss (Correspondence)." 1969 Transactions on Microwave Theory and Techniques 17.9 (Sep. 1969 [T-MTT]): 724-726.

In 1961 Bell and Rupprecht reported a resonance method for measurement of small dielectric losses as a function of temperature at constant frequency. Recently Gastine et al., have determined the complex frequencies required to make a sphere of known material resonate and confirmed their results by measurements. The purpose of this correspondence is to demonstrate that a large dielectric constant with small loss can be easily determined as a function of frequency from the resonant frequencies which can be readily measured.

Abstracts

Three-Phase Separator for Circular Polarization (Correspondence)

D. Kajfez. "Three-Phase Separator for Circular Polarization (Correspondence)." 1969 Transactions on Microwave Theory and Techniques 17.9 (Sep. 1969 [T-MTT]): 726-727.

The characteristics of a plane electromagnetic wave are described by specifying the two orthogonal polarization components that consitiute the wave. It is common practice to measure the two linearly polarized components of a wave. There is much less knowledge about the procedure of decomposing a plane wave into its circularly polarixed components, although such decomposition might be more natural in some situations, This correspondence reports on efforts to build a microwave system that makes possible direct simultaneous measurement of two circularly polarixed components, without previous decomposition into linearly polarized components. The principle of operation is similar to a three-phase system widely used in power transmission.

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Distortion of a Narrow-Band FM Signal in a Lossless Abrupt-Junction Nonoverdriven Varactor Doubler (Correspondence)

A.I. Grayzel. "Distortion of a Narrow-Band FM Signal in a Lossless Abrupt-Junction Nonoverdriven Varactor Doubler (Correspondence)." 1969 Transactions on Microwave Theory and Techniques 17.9 (Sep. 1969 [T-MTT]): 727-728.

The output waveform of a non-overdriven, abrupt-junction varactor doubler is given for a narrow-band FM input signal. The results for a hyperabrupt junction varactor with V= q/sup n/ are also given.

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Subharmonically Injection Phase-Locked Gunn Oscillator Experiments (Correspondence)

H.G. Oltman and C.H. Nonnemaker. "Subharmonically Injection Phase-Locked Gunn Oscillator Experiments (Correspondence)." 1969 Transactions on Microwave Theory and Techniques 17.9 (Sep. 1969 [T-MTT]): 728-729.

A GaAs microwave diode oscil-lator has been subharmonically injection phase locked at frequency ratios as low as 1:6. Maximum locking ranges are less than those observed when there is direct frequency locking, and decrease with decreasing ratio. The locking range-locking gain slopes are all greater than one decade per 20 dB of locking gain. The maximum locking range at a subharmonic ratio of 1:2 is 0.6 percent and is only slightly less than that observed by others at 1:1 ratio. Under certain conditions, simultaneous Gunn oscillating at a frequency near the subharmonic injection frequency was ohserved.

Abstracts

Half-Height Waveguide Y and T Circulators (Correspondence)

E. Friebergs. "Half-Height Waveguide Y and T Circulators (Correspondence)." 1969 Transactions on Microwave Theory and Techniques 17.9 (Sep. 1969 [T-MTT]): 729-730.

The constructional details of half-height waveguide X-hnnd Y and T junction circulators are described and their performance characteristics are presented.

Abstracts

Contributors (Sep. 1969 [T-MTT])

D.K. Adams, D.J. Blattner, J.E. Dalley, C.N. Dunn, L.B. Felsen, A. Gopinath, R.Y.C. Ho, J.S. Hornsby, G.L. Millican, R.W. Paglione, W.W. Siekanowicz, R.C. Wales, T.E. Walsh and H.Y. Yee. "Contributors (Sep. 1969 [T-MTT])." 1969 Transactions on Microwave Theory and Techniques 17.9 (Sep. 1969 [T-MTT]): 731-732.

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On Determining the Capacitances of Shielded Multiconductor Transmission Lines

P.C. Chestnut. "On Determining the Capacitances of Shielded Multiconductor Transmission Lines." 1969 Transactions on Microwave Theory and Techniques 17.10 (Oct. 1969 [T-MTT]): 734-745.

A numerical method for computing the capacitances of n conductors located inside a grounded rectangle is presented. The method is based on an integral equation for the charge densities on the conductors with a Green's function as kernel. The integral equation is solved numerically by replacing the integral with a finite sum, using a Gaussian quadrature formula. The feasibility of the method depends on each conductor having a simple analytical description (circle, ellipsoid, straight line, etc.). As an illustration, graphs are shown giving the dimensions of an offset pair of zero-thickness strips versus coupling coefficient for a 50-ohm transmission line for various sizes of the grounded rectangle.

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Coupled-Mode Analysis of Nonuniform Coupled Transmission Lines

J.E. Adair and G.I. Haddad. "Coupled-Mode Analysis of Nonuniform Coupled Transmission Lines." 1969 Transactions on Microwave Theory and Techniques 17.10 (Oct. 1969 [T-MTT]): 746-752.

The transmission-line equations describing propagation along coupled transmission lines are cast in coupled-mode form so that the roles of the different coupling coefficients and the impedance variation are more directly observable. Restrictions on the various parameters for obtaining directional coupling with nonuniform lines are then discussed and exact solutions for the coupling response of two nonuniform coupled lines with particular variations of the coupling coefficients are presented. The results obtained from the exact closed-form solutions should aid in the design of tapered couplers.

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Coupled Transmission Line Networks in an Inhomogeneous Dielectric Medium (Oct. 1969 [T-MTT])

G.I. Zysman and A.K. Johnson. "Coupled Transmission Line Networks in an Inhomogeneous Dielectric Medium (Oct. 1969 [T-MTT])." 1969 Transactions on Microwave Theory and Techniques 17.10 (Oct. 1969 [T-MTT]): 753-759.

In this paper, two-port networks composed of two identical, coupled transmission lines embedded in an inhomogeneous dielectric (e.g., suspended substrate, microstrip) are investigated. The ABCD parameters of circuit configurations, considered by Jones and Bolljahn, are obtained for the case of inhomogeneous dielectilc. Equivalent circuits of these networks are also given. It is shown that the characteristics of such circuits differ markedly from those embedded in a homogeneous medium. In addition, experimental results are presented for three types of circuits which have been constructed and tested. There is excellent agreement between the experimental results and those predicted theoretically on the basis of the equivalent circuits.

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A Grating Formulation for Some Problems Involving Cylindrical Discontinuities in Rectangular Waveguides

R.B. Green. "A Grating Formulation for Some Problems Involving Cylindrical Discontinuities in Rectangular Waveguides." 1969 Transactions on Microwave Theory and Techniques 17.10 (Oct. 1969 [T-MTT]): 760-763.

A representation of the Green's function for a line current in a rectangular waveguide is given in terms of a rapidly converging series. One can obtain numerical results for a wide class of practical problems by combining this representation with the "method of moments." The technique is discussed in general and applied to the problem of computing the reflection coefficients of circular posts in waveguides. Post diameters from 0.14 to 0.97 times the guide width are considered and theoretical results are found to be in good agreement with experimental studies.

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Abstracts

The Filling Factor of Shielded Dielectric Resonators

J.-L. Pellegrin. "The Filling Factor of Shielded Dielectric Resonators." 1969 Transactions on Microwave Theory and Techniques 17.10 (Oct. 1969 [T-MTT]): 764-768.

The use of dielectric resonators at microwave frequencies usually requires a shield to prevent loss of energy by radiation, and a coupling network. The efficiency of a given circuit depends on the filling factor, which expresses the circuit ability to store most of the input energy in the resonator, and little in the coupling network and surrounding space. The resonator is sometimes excited by means of a coupling loop inside the shield, or with a propagating waveguide. In any case, some energy is stored outside the dielectric material. A calculation is presented for the internal and external stored energies, for the case of a rectangular dielectric resonator in a rectangular waveguide. Verification was performed by measuring the insertion loss of an acoustic delay line, which illustrates an interesting application of dielectric resonators.

Abstracts

Slot Line on a Dielectric Substrate

S.B. Cohn. "Slot Line on a Dielectric Substrate." 1969 Transactions on Microwave Theory and Techniques 17.10 (Oct. 1969 [T-MTT]): 768-778.

Slot line consists of a narrow gap in a conductive coating on one side of a dielectric substrate, the other side of the substrate being bare. If the substrate's permittivity is sufficiently high, such as /spl epsiv//sub r/ = 10 to 30, the slot-mode wavelength will be much smaller than free-space wavelength, and the fields will be closely confined near the slot. Possible applications of slot line to filters, couplers, ferrite devices, and circuits containing semiconductor elements are discussed. Slot line can be used either alone or with microstrip line on the opposite side of the substrate. A "second-order" analysis yields formulas for slot-line wavelength, phase velocity, group velocity, characteristic impedance, and effect of adjacent electric and magnetic walls.

Abstracts

Current Distribution in Barretters and Its Application to Microwave Power Measurements

J.W. Adams and S. Jarvis, Jr.. "Current Distribution in Barretters and Its Application to Microwave Power Measurements." 1969 Transactions on Microwave Theory and Techniques 17.10 (Oct. 1969 [T-MTT]): 778-785.

This paper describes a mathematical analysis for determining the microwave current distribution in a barretter in a rectangular waveguide. This distribution, when used with another analysis which calculates substitution error for any given current distribution, provides a missing step necessary for the calibration of microwave and millimeter-wave barretters for absolute power measurements.

Abstracts

Calculation of Waveguide Junction and Diaphragm Interactions

L. Lewin. "Calculation of Waveguide Junction and Diaphragm Interactions." 1969 Transactions on Microwave Theory and Techniques 17.10 (Oct. 1969 [T-MTT]): 785-788.

It is shown that where the equation for a waveguide junction field can be expressed in the form of a singular integral equation, the use of a linear transformation of the variables enables the transformed equation to refer to the junction with an inserted diaphragm. The transformed equation is solved for two particular cases. In the first, a bifurcated waveguide, the solution to the diaphragm configuration can be written down almost by inspection. The equivalent circuit is not altered by the diaphragm though the values of the circuit elements are modified. In the second, a waveguide step, a more complicated and less obvious transformation is required. The method works for a diaphragm on one wall of the guide but not on the other, due to current limitations in the theory of singular integral equations.

Abstracts

A Upsilon to Delta Transformation of a Three-Way Hybrid Junction (Correspondence)

J.H. Lange, Jr. and B.E. Rose. "A Upsilon to Delta Transformation of a Three-Way Hybrid Junction (Correspondence)." 1969 Transactions on Microwave Theory and Techniques 17.10 (Oct. 1969 [T-MTT]): 789-790.

A three-way power divider/summer in the Wilkinson configuration can be symmetrically fabricated in stripline if the /spl Upsilon/ resistive balancing network is replaced by a /spl Delta/ resistive network. Port-to-port isolation in a stripline circuit at 2 GHz exceeded 27 dB; loss was below 0.15 dB.

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A Peak Power Threshold Approximation for Remanent Ferrite Phase Shifters (Correspondence)

R.R. Kinsey. "A Peak Power Threshold Approximation for Remanent Ferrite Phase Shifters (Correspondence)." 1969 Transactions on Microwave Theory and Techniques 17.10 (Oct. 1969 [T-MTT]): 790-790.

A parametric relationship is presented that permits an estimation of phase shifter peak power threshold level. The experimentally observed effect of a load mismatch on the peak power threshold is also reported.

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Subroutine PERM (Program Description)

A.M. Auckenthaler. "Subroutine PERM (Program Description)." 1969 Transactions on Microwave Theory and Techniques 17.10 (Oct. 1969 [T-MTT]): 791-792.

The algorithm computes the permanent of a square matrix which has been shown to yield the number of loops in a microwave network flow graph.

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J.E. Adair, J.W. Adams, P.C. Chestnut, S.B. Cohn, R.B. Green, G.I. Haddad, S. Jarvis, Jr., A.K. Johnson, L. Lewin, J.-L. Pellegrin and G.I. Zysman. "Contributors (Oct. 1969 [T-MTT])." 1969 Transactions on Microwave Theory and Techniques 17.10 (Oct. 1969 [T-MTT]): 793-794.

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"Information for Authors (Oct. 1969 [T-MTT])." 1969 Transactions on Microwave Theory and Techniques 17.10 (Oct. 1969 [T-MTT]): 795-795.

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Membership Application (Oct. 1969 [T-MTT])

"Membership Application (Oct. 1969 [T-MTT])." 1969 Transactions on Microwave Theory and Techniques 17.10 (Oct. 1969 [T-MTT]): 796-796.

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Editor's Note (Nov. 1969 [T-MTT])

G.I. Haddad. "Editor's Note (Nov. 1969 [T-MTT])." 1969 Transactions on Microwave Theory and Techniques 17.11 (Nov. 1969 [T-MTT] (Special Issue on Microwave Acoustics)): 798-798.

Microwave acoustics is becoming a very important area for microwave engineers and work in this area is presently being carried out at various laboratories. The area of microwave acoustics is a natural one for microwave engineers to get involved in because of its similarity to classical microwave theory and techniques. The purpose of this issue is to bring to the attention of the microwave engineer the work being done in this area and the problems that require further investigation. It is hoped that this issue will bring out the relevance between classical microwave theory and techniques and microwave acoustics.

Abstracts

Introduction (Nov. 1969 [T-MTT])

A.J. Bahr. "Introduction (Nov. 1969 [T-MTT])." 1969 Transactions on Microwave Theory and Techniques 17.11 (Nov. 1969 [T-MTT] (Special Issue on Microwave Acoustics)): 799-799.

What has acoustics to do with the G-MTT? The answer to that question lies in a recent amendment to the G-MTT constitution. I quote from Article III (entitled "Field of Interest"), Section 1b: "Microwave Theory and Techniques are related to electromagnetic waves usually in the frequency region between 1-100 GHz; other spectral regions and wave types are included within the scope of the Group whenever basic microwave theory and techniques can yield useful results. Generally, this occurs in the theory of wave propagation in structures with dimensions comparable to a wavelength, and in the related techniques for analysis and design. . . ."

Abstracts

Application of Microwave Concepts to the Theory of Acoustic Fields and Waves in Solids

B.A. Auld. "Application of Microwave Concepts to the Theory of Acoustic Fields and Waves in Solids." 1969 Transactions on Microwave Theory and Techniques 17.11 (Nov. 1969 [T-MTT] (Special Issue on Microwave Acoustics)): 800-811.

During the past 20 years the value of the microwave approach to electromagnetic field problems has been amply demonstrated. The purpose of this paper is to show the basic similarity of acoustic and electromagnetic field equations and to exploit this fact in applying microwave methods to acoustic resonator and waveguide problems. This is accomplished most directly and efficiently by using symbolic notation, rather than tensor subscripts, for the acoustic fields. The usefulness of this notation is illustrated by the problems of plane wave propagation and piezoelectric stiffening in an anisotropic medium, and by derivations of Poynting's and reciprocity theorems for a piezoelectric medium. Piezoelectric resonators are treated in detail from the point of view of normal mode expansions. A general network representation is obtained and is applied to the disk transducer, as an example. Normal mode theory of piezoelectric waveguides is briefly sketched and a perturbation theorem, which can be applied to both resonator and waveguide problems, is derived.

Abstracts

Microwave Network Methods for Guided Elastic Waves

A.A. Oliner. "Microwave Network Methods for Guided Elastic Waves." 1969 Transactions on Microwave Theory and Techniques 17.11 (Nov. 1969 [T-MTT] (Special Issue on Microwave Acoustics)): 812-826.

The possibility of obtaining true microminiaturization by the use of elastic wave circuitry on solids is hampered by the lack of knowledge regarding the behavior of the constituents of those circuits. Since boundary value problems involving elastic waves in solids are generally very intricate and difficult to solve, a direct frontal attack on those problems will in many cases lead to frustration. In this paper, a series of steps is outlined which avoids the frontal attack and lends itself to a systematic procedure for achieving the understanding sought. It involves the application of concepts and techniques of proven value in electromagnetic microwaves to corresponding categories of problems in elastic guided waves. To demonstrate the value of this approach, it is used to derive the properties of several well-known types of elastic wave on layered media, such as Rayleigh surface waves, leaky Rayleigh waves, Lamb waves, and Love waves. In the building-block approach employed, the results derived separately include transmission-line models for body waves in fluids and isotropic solids, with expressions for the characteristic impedances and the velocity and stress vector mode functions, and equivalent networks for several types of interface which are constituents of the layered media mentioned above. The propagation properties of the guided waves are then obtained by the use of the transverse resonance procedure in a systematic, simple, and direct fashion.

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Abstracts

Excitation of Elastic Waves in Crystals

K.A. Ingebrigtsen and A. Tonning. "Excitation of Elastic Waves in Crystals." 1969 Transactions on Microwave Theory and Techniques 17.11 (Nov. 1969 [T-MTT] (Special Issue on Microwave Acoustics)): 827-835.

Excitation of elastic waves in a general anisotropic crystal is discussed. The crystal is supposed to be semi-infinite, bounded by a plane surface. The definition of an elastic impedance matrix for the medium and its use in the subsequent discussion emphasize the similarities with transmission line theory. The resulting expressions for the amplitudes of bulk waves and surface waves is expressed in a matrix formalism believed to have computational advantages.

Abstracts

Microsound Components, Circuits, and Applications

E. Stern. "Microsound Components, Circuits, and Applications." 1969 Transactions on Microwave Theory and Techniques 17.11 (Nov. 1969 [T-MTT] (Special Issue on Microwave Acoustics)): 835-844.

Surface acoustic wave components have been realized which perform the functions of transduction, amplification, and coupling. Applications are suggested which make use of these components. Exploratory work in connection with surface acoustic waveguides suggests the feasibility of acoustic analogs of conventional microwave transmission line (microsound) components on the surface of crystal and substrates. These microsound transmission lines, hybrids, and directional couplers interconnect microsound transducers, amplifiers, isolators, and phase shifters to form microsound circuits capable of autocorrelation, Fourier transformation, and cross correlation functions. Compatible component configurations are proposed and evaluated which perform these basic functions. The anticipated difficulties with their realization are discussed and the current status of critical problems including the epitaxial growth of thin films and submicron etching procedures will be given. Several circuits capable of performing correlation functions are given.

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Abstracts

The Generation and Propagation of Acoustic Surface Waves at Microwave Frequencies

P.H. Carr. "The Generation and Propagation of Acoustic Surface Waves at Microwave Frequencies." 1969 Transactions on Microwave Theory and Techniques 17.11 (Nov. 1969 [T-MTT] (Special Issue on Microwave Acoustics)): 845-855.

The generation and propagation of acoustic surface waves is reviewed with particular emphasis on the microwave-frequency range. Theoretical work on optimizing the generation efficiency and the bandwidth of interdigital transducers is compared with recent experimental results. The minimum Iinewidth of 0.9 µm which can be produced by optical photolithographic techniques places an upper limit of about 1 GHz on the maximum frequency that can be generated at the fundamental mode. Overtone operation has been used to generate 3 GHz surface waves on LiNbO/sub 3/ but this method has the disadvantage of reduced efficiency plus the complication of volume-wave generation. A better solution for generation above 1 GHz is the fabrication of interdigital transducers by means of electron beam exposure of the photoresist. The surface-wave propagation loss gives a significant contribution to the total insertion loss of delay lines operating at microwave frequencies. Losses of 1.1 dB/µs and 3.8 dB/µs at 0.9 GHz and 2 GHz, respectively, have been measured for propagation along the Z-direction of Y-cut LiNbO/sub 3/ by means of a laser deflection method. Larger losses have been observed for quartz. The additional complexities for surface-wave propagation due to the anisotropic single-crystal substrates which are necessary at microwave frequencies are also described.

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Analysis of Interdigital Surface Wave Transducers by Use of an Equivalent Circuit Model

W.R. Smith, H.M. Gerard, J.H. Collins, T.M. Reeder and H.J. Shaw. "Analysis of Interdigital Surface Wave Transducers by Use of an Equivalent Circuit Model." 1969 Transactions on Microwave Theory and Techniques 17.11 (Nov. 1969 [T-MTT] (Special Issue on Microwave Acoustics)): 856-864.

Immittance, transfer, and scattering characteristics are studied for acoustic surface wave transducers of the interdigital electrode form. Linear network models are used to represent the transducer as a chain of identical three-ports which are acoustically in cascade but electrically in parallel. Transducer operation at acoustic synchronism is described theoretically and compared to current experimental data for transducers operating at 100 MHz and fabricated on lithium niobate. Favorable lithium niobate configurations for efficient, broad-band transducer operation are given. Scattering characteristics as a function of electric load are discussed. Low values of acoustic reflection loss are predicted theoretically and observed experimentally when the electric load and transducer capacitance are in resonance. The frequency dependence of transducer radiation immittance is studied, and the response is found to be analogous to the response of an endfire antenna array.

Abstracts

Design of Surface Wave Delay Lines with Interdigital Transducers

W.R. Smith, H.M. Gerard, J.H. Collins, T.M. Reeder and H.J. Shaw. "Design of Surface Wave Delay Lines with Interdigital Transducers." 1969 Transactions on Microwave Theory and Techniques 17.11 (Nov. 1969 [T-MTT] (Special Issue on Microwave Acoustics)): 865-873.

Design aspects and tradeoffs are presented for nondispersive, analog Rayleigh wave delay lines with interdigital transducers. Design procedures are based on a one-dimensional piezoelectric transducer model whose applicability has been confirmed by experimental data taken on transducers operating at 100 MHz. For transducers with series inductive tuning, optimum aperture and number of interdigital periods are given for several attractive piezoelectrics, such that insertion loss and phase dispersion are minimized while bandwidth is maximized. High-triple transit suppression designs are given for bidirectional transducers, implying some sacrifice in insertion loss. Using directional transducers, low insertion loss and high triple transit suppression are achieved simultaneously at some sacrifice in bandwidth. Finally, two approaches are given for making with presently available piezoelectrics, bandwidths higher than those attainable with a single tuning inductor. The first of these uses a coupled resonator electrical matching network, while the second employs a transducer with graded periodicity.

Abstracts

Piezoelectric Rayleigh Wave Excitation by Bulk Wave Scattering

H.L. Bertoni. "Piezoelectric Rayleigh Wave Excitation by Bulk Wave Scattering." 1969 Transactions on Microwave Theory and Techniques 17.11 (Nov. 1969 [T-MTT] (Special Issue on Microwave Acoustics)): 873-882.

The excitation of a Rayleigh surface wave on a piezoelectric crystal by the scattering of bulk waves from strips deposited on the crystal's surface is considered. Using small scatterer approximations to obtain a lower limit for the strength of excitation that can be obtained by the scattering method, the Rayleigh wave excitation resulting from the mass of the deposited strips is determined. Numerical calculations for CdS, LiNbo/sub 3/, and isotropic solids indicate that this method of excitation is feasible. Simple, small scatterer estimates for the order of magnitude of the excitation resulting from the conductivity of strips deposited on CdS and LiNbO /sub 3/suggest that the Rayleigh wave can be more strongly excited through the mass of the strips than through their conductivity. In order to evaluate the Rayleigh wave excitation, an expression has been derived that describes the excitation of elastic surface waves, guided by configurations composed of infinite, parallel layers of arbitrary piezoelectric and elastic materials, when the source of these waves are prescribed, two-dimensional force and current distributions. This expression for the surface wave excitation coefficient depends only on the source and the properties of the surface wave, and is expected to prove useful in rating a wide variety of exciting structures. For the scattering method of excitation considered here, the effect of the incident bulk wave on the strips can be represented by approximately equivalent sources, which excite the surface wave.

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Microsound Surface Waveguides

E.A. Ash, R.M. De La Rue and R.F. Humphryes. "Microsound Surface Waveguides." 1969 Transactions on Microwave Theory and Techniques 17.11 (Nov. 1969 [T-MTT] (Special Issue on Microwave Acoustics)): 882-892.

An important requirement for the development of surface wave microsound systems is the ability to guide the energy. The theoretical and experimental progress towards this aim is reviewed. Some preliminary results on topographic guides are presented. Measurement techniques make use of phase-sensitive laser probes to detect the CW surface waves. The technique permits very accurate determination of dispersion characteristics.

Abstracts

Some Problems in the Theory of Guided Microsonic Waves

R.A. Waldron. "Some Problems in the Theory of Guided Microsonic Waves." 1969 Transactions on Microwave Theory and Techniques 17.11 (Nov. 1969 [T-MTT] (Special Issue on Microwave Acoustics)): 893-904.

The wave equation for elastic waves in an isotropic solid is solved generally in Cartesian and in circular cylindrical coordinates. The solutions are applied in the study of a variety of guiding structures of circular and rectangular symmetry. In general, the wave functions do not satisfy the boundary conditions, but in special cases they do. From a study of these special cases it is possible to arrive at some useful results and to general principles which give some insight into the behavior of waveguides in general. The results and observations obtained are compared and where appropriate, with corresponding results for electromagnetic waveguides.

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Abstracts

Elastic Surface Waves Guided by Thin Films: Gold on Fused Quartz

L.R. Adkins and A.J. Hughes. "Elastic Surface Waves Guided by Thin Films: Gold on Fused Quartz." 1969 Transactions on Microwave Theory and Techniques 17.11 (Nov. 1969 [T-MTT] (Special Issue on Microwave Acoustics)): 904-911.

To study some of the properties of acoustic waves guided by thin films, experiments on dispersion and transverse tightness of binding were performed in the frequency range 5 MHz to 14 MHz. The movable wedge technique of launching and receiving surface wave signals was utilized. The guidance structure consisted of thin gold films deposited on fused quartz. High resolution experimental results were obtained by modifying the wedges to have a very narrow active region. The data were compared to results predicted by a simplified theoretical model which we have developed. This model is complementary to that of Tiersten in that we match both components of the vector potential while in Tiersten's model one matches a single vector potential component and its normal derivative. Curves calculated by our approach appear to be virtually identical with those of Tiersten for the (width/thickness) ratios treated experimentally, but are much easier to obtain numerically for any particular value of the ratio. For smaller values of the (width/thickness) ratio, our model and that of Tiersten differ slightly. Data for dispersion and mode tightness of binding were found to be in substantial agreement with our theoretical predictions. In addition, the theoretical model predicts features such as location of low-frequency cutoffs and tightness of binding of the antisymmetric modes which have not been completely investigated experimentally.

Abstracts

Surface Wave Delay Line Amplifiers

K.M. Lakin and H.J. Shaw. "Surface Wave Delay Line Amplifiers." 1969 Transactions on Microwave Theory and Techniques 17.11 (Nov. 1969 [T-MTT] (Special Issue on Microwave Acoustics)): 912-920.

The subject of acoustoelectric surface wave delay line amplification is reviewed. Two amplifier configurations are defined: the combined medium amplifier (CMA), and the separated medium amplifier (SMA). These configurations are compared and the problems associated with each one defined. A more detailed description of the SMA is given along with experimental results. A brief analysis is presented; two material constants are defined, and then used to compare materials in terms of SMA applicability at high frequencies.

Abstracts

Piezoelectric Elastic Surface Waves in Anisotropic Layered Media

R.V. Schmidt and F.W. Voltmer. "Piezoelectric Elastic Surface Waves in Anisotropic Layered Media." 1969 Transactions on Microwave Theory and Techniques 17.11 (Nov. 1969 [T-MTT] (Special Issue on Microwave Acoustics)): 920-926.

Solutions for surface elastic waves propagating in a layered media consisting of a CdS film on a fused quartz substrate have been found. Piezoelectric coupling in the CdS has been included. The Rayleigh, Sezawa, and Love modes are discussed. The surface wave velocity, mechanical displacements, and electric fields are found as a function of layer thickness for the Rayleigb and Sezawa modes. Velocity dispersion was experimentally measured and found to be in good agreement with theory.

Abstracts

Characteristics of Microwave Acoustic Transducers for Volume Wave Excitation

T.M. Reeder and D.K. Winslow. "Characteristics of Microwave Acoustic Transducers for Volume Wave Excitation." 1969 Transactions on Microwave Theory and Techniques 17.11 (Nov. 1969 [T-MTT] (Special Issue on Microwave Acoustics)): 927-941.

Transducers which utilize acoustoelectric conversion in a piezoelectric film, plate, or surface have found wide application for generating planar volume-acoustic waves at microwave frequencies. A review is given of the electrical impedance, conversion loss, and bandwidth characteristics for piezoelectric film or plate transducers which vibrate in one-dimensional thickness extensional or shear modes. The transducer response is related to the electric and acoustic parameters that describe the transducer configuration, and experimental examples are given to illustrate the operation of typical transducer configurations. Methods for achieving low conversion loss and/or broad bandwidth are discussed and experimental examples given. Tables of bulk material constants are supplied for commonly used plate and film devices, and transducer fabrication methods are reviewed. Other types of volume wave transducers, such as those utilizing a single piezoelectric surface, a diffusion layer in a piezoelectric semiconductor, or mode conversion at a boundary are also briefly discussed.

Abstracts

Determination of Microwave Transducer and Delay-Line Properties with a Modified Nodal Shift Method

G. Rupprecht and R.F. Steinberg. "Determination of Microwave Transducer and Delay-Line Properties with a Modified Nodal Shift Method." 1969 Transactions on Microwave Theory and Techniques 17.11 (Nov. 1969 [T-MTT] (Special Issue on Microwave Acoustics)): 942-956.

A mathematical analysis of the input impedance to a single-ended delay line is given and the developed formulas are applied to the experimental data to yield: sound velocity and round-trip time in the delay medium, electromechanical coupling coefficient, series resistance, transducer capacity, and the acoustical loss and mismatch which is caused by the electrode structure. A measuring technique similar to the nodal shift method has been introduced.

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Piezoelectric Semiconductor Acoustic Delay Lines

F.S. Hickernell. "Piezoelectric Semiconductor Acoustic Delay Lines." 1969 Transactions on Microwave Theory and Techniques 17.11 (Nov. 1969 [T-MTT] (Special Issue on Microwave Acoustics)): 957-963.

The delay of signals for microsecond time periods in monolithic structures using piezoelectric semiconductors is described. Thin resistive regions were formed by the diffusion of compensating impurities in semiconducting crystals of ZnO, CdS, CdSe, and GaAs and used as transducers for the excitation and detection of acoustic waves in the 30-MHz to 1.0-GHZ region. Time delays from 200 ns to 5.0 µs were achieved using simple acoustic transmission structures. Insertion loss values less than 10 dB were achieved in ZnO for microsecond delays up to 600 MHz. Frequency-tuned bandwidths of 70 to 90 percent were obtained. The frequency-loss characteristics of the delay structures could be quantitatively related to a simple theoretical model. The performance characteristics of representative matched and packaged acoustic delay lines is described.

Abstracts

Microwave Acoustic Simulation of Airborne Radar Ground Echoes

H.V. Hance and W.I. Dobrov. "Microwave Acoustic Simulation of Airborne Radar Ground Echoes." 1969 Transactions on Microwave Theory and Techniques 17.11 (Nov. 1969 [T-MTT] (Special Issue on Microwave Acoustics)): 963-967.

A method is described for generating simulated microwave frequency radar terrain echoes. This method makes it possible for the first time to realistically duplicate in the laboratory the principal characteristics of echoes due to radar motion and terrain roughness. These characteristics include variation of echo delay, Doppler shift, random fine structure, and their time variation. The simulation is based on modeling of the radar beam propagation and diffuse reflection processes by use of microwave acoustic energy in a solid medium. Scaling relations between radar and acoustic model parameters are derived. An experimental program was carried out whose purpose was to develop a practical solution to the problem of varying the distance between a microwave acoustic transducer and a reflecting surface, and to determine the overall feasibility of the simulation method. Results indicating its practicability are presented and directions for further work are suggested.

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Abstracts

Microwave Acoustic Devices for Pulse Compression Filters

I.N. Court. "Microwave Acoustic Devices for Pulse Compression Filters." 1969 Transactions on Microwave Theory and Techniques 17.11 (Nov. 1969 [T-MTT] (Special Issue on Microwave Acoustics)): 968-986.

The ability of devices based on the phenomena of magnetoelastic waves, acoustic bulk waves, acoustic surface waves, and the optoacoustic interaction to fulfill the requirements for a dispersive filter for a pulse compression radar are reviewed. The performance and current limitations of devices that use techniques employing these effects are described. The discussion is generally limited to devices which have been operated in the frequency range above 100 MHz. For comparison, other solid-state techniques that do not employ acoustic waves which can be used to make dispersive filter are described.

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Abstracts

Microwave Variable Delay Devices

E.K. Kirchner. "Microwave Variable Delay Devices." 1969 Transactions on Microwave Theory and Techniques 17.11 (Nov. 1969 [T-MTT] (Special Issue on Microwave Acoustics)): 986-997.

Needs for nondispersive microwave variable delay devices exist in radar, communication, ECM, and test systems. Methods which have been investigated to satisfy these needs are reviewed in this paper. Techniques that employ solid-state microwave acoustic interactions and that have promise of satisfying some of the microwave variable delay requirements are described in detail, and their present capabilities and potential capabilities are discussed. One technique employing magnetoelastic waves is particularly promising and the state of the art of this technique is analyzed thoroughly.

Abstracts

L-Band Variable-Delay-Time YIG-YAG-YIG and YAG-YIG-YAG Delay Lines

A.B. Smith. "L-Band Variable-Delay-Time YIG-YAG-YIG and YAG-YIG-YAG Delay Lines." 1969 Transactions on Microwave Theory and Techniques 17.11 (Nov. 1969 [T-MTT] (Special Issue on Microwave Acoustics)): 997-1001.

Two types of YIG variable-delay-time microwave delay lines are described. These are the YIG-YAG-YIG and YAG-YIG-YAG configurations, both of which provide /spl sim/2 µs of variable delay in L-band. Two-port operation is achieved in both of these devices with leakage of the undelayed pulse between input and output being attenuated more than 100 dB. These are completely self-contained devices with internal permanent magnets and terminals for connecting a control signal to vary the delay time. Insertion loss, bandwidth, and VSWR data are presented as well as curves showing delay variation with control current. A comparison of these two types of delay lines is also presented, pointing out the advantages and disadvantages of each type.

Abstracts

Guided-Wave Theory of Light Diffraction by Acoustic Microwaves (Nov. 1969 [T-MTT])

R.-S. Chu and T. Tamir. "Guided-Wave Theory of Light Diffraction by Acoustic Microwaves (Nov. 1969 [T-MTT])." 1969 Transactions on Microwave Theory and Techniques 17.11 (Nov. 1969 [T-MTT] (Special Issue on Microwave Acoustics)): 1002-1020.

The diffraction of a plane light wave incident obliquely upon an isotropic dielectric layer traversed longitudinally by an acoustic microwave is examined by means of a guided-wave approach. In addition to a considerable amount of physical insight, this approach provides a wide range of techniques that have already been developed extensively in the area of electromagnetic microwaves. As a consequence, available methods can be used to explain and express known aspects of the diffracted light in terms of simple guided-wave concepts which are applied herein to derive results that have not been available. It is shown that the difracted field within the dielectric layer, as well as in the exterior (air) medium, can be described by means of two alternative modal representations: 1) a description in terms of characteristic modes which progress independently of each other, and 2) a description in terms of coupled modes which interact with each other in the presence of the acoustic wave. While the two representations are equivalent, each has its own advantages and both are discussed in detail. It is also shown that these representations lead to equivalent networks that may be utilized to account for boundary conditions and for other features of the scattered field. In particular, diffraction phenomena in a Bragg regime are carefully investigated; qualitative and quantitative results are presented for situations wherein the orientation of the optic-acoustic interaction occurs at a Bragg angle of arbitrary order.

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Abstracts

Linear Signal Processing and Ultrasonic Transversal Filters

W.D. Squire, H.J. Whitehouse and J.M. Alsup. "Linear Signal Processing and Ultrasonic Transversal Filters." 1969 Transactions on Microwave Theory and Techniques 17.11 (Nov. 1969 [T-MTT] (Special Issue on Microwave Acoustics)): 1020-1040.

The role of linear transversal filters in signal processing is discussed in Section I. Linear filters for signal processing must often have complicated impulse responses, with large bandwidth and large time bandwidth product. The linear transversal falter, a delay line with weighted and summed taps, is ideally suited for the implementation of such filters because of its simplicity of synthesis. The filter's impulse response is derived by the application of some concepts from the theories of vector spaces and sampling, and is shown to be equal to the tap weighting function. Thus, the synthesis procedure consists merely of sampling the specified impulse response at appropriate intervals and using the sample values as the tap weights. The utility of the transversal filter in signal processing is illustrated by an example from scatterer distribution mapping. The illustration is applied to two hypothetical systems--a sonar and an astronomical radar. In both these cases, it is not possible for a single filter to process the signal in real time. Signal processing in compressed time is discussed as an alternative to the use of a large number of filters in parallel. If the processing filter has a bandwidth capability in excess of the signal's bandwidth, the signal can be time compressed and processed serially in time. A generalized receiver, employing time compression, frequency translation, and multiple-output-port transversal filtering, is developed from these ideas. In Section II, a generalized transversal filter is described and analyzed. A delay line with multiple arrays of taps, each array with a multiplicity of weighting functions, has as the impulse response between any pair of ports the cross-correlation function of the weighting functions for the two ports. A number of implementations of transversal filters employing a variety of delay line types are described and some aspects of transduction and wave propagation in bounded media are presented in relation to these implementations.

Abstracts

Active Impedance Matching for Microwave Acoustic Delay Lines (Correspondence)

R.Y.C. Ho and A.J. Bahr. "Active Impedance Matching for Microwave Acoustic Delay Lines (Correspondence)." 1969 Transactions on Microwave Theory and Techniques 17.11 (Nov. 1969 [T-MTT] (Special Issue on Microwave Acoustics)): 1041-1042.

Some experimental results are presented which demonstrate the feasibility of using transistor circuits (of the inverted common-collector type) as elements in impedance-matching networks for microwave acoustic delay lines. This technique is shown to offer the possibility of realizing matched delay lines having both low insertion loss and low spurious triple-transit echo level.

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Abstracts

Analog Matched Filter Using Tapped Accoustic Surface Wave Delay Line (Correspondence)

S.T. Costanza, P.J. Hagon and L.A. MacNevin. "Analog Matched Filter Using Tapped Accoustic Surface Wave Delay Line (Correspondence)." 1969 Transactions on Microwave Theory and Techniques 17.11 (Nov. 1969 [T-MTT] (Special Issue on Microwave Acoustics)): 1042-1043.

VHF experiments are described employing 11- and 50-tap surface acoustic wave delay lines fabricated on crystalline quartz as analog matched filters. Excellent correlation characteristics were observed for a 63-bit maximal length biphase code.

Abstracts

Dispersive Rayleigh Wave Delay Line Utilizing Gold on Lithium Niobate (Correspondence)

W.R. Smith, T.M. Reeder, J.H. Collins, H.J. Shaw and W.W. Hansen. "Dispersive Rayleigh Wave Delay Line Utilizing Gold on Lithium Niobate (Correspondence)." 1969 Transactions on Microwave Theory and Techniques 17.11 (Nov. 1969 [T-MTT] (Special Issue on Microwave Acoustics)): 1043-1044.

The dispersion characteristics have been obtained for a gold film overlay on lithium niobate into which Rayleigh waves around 100 MHz are injected. Phase and attenuation measurements are conducted continuously as the gold film is deposited under vacuum conditions. Linear increase of delay with frequency is observed for a gold thickness approximating 5000 /spl Aring/.

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Abstracts

Acoustic Scattering Parameters of the Electrically Loaded Interdigital Surface Wave Transducer (Correspondence)

H.M. Gerard. "Acoustic Scattering Parameters of the Electrically Loaded Interdigital Surface Wave Transducer (Correspondence)." 1969 Transactions on Microwave Theory and Techniques 17.11 (Nov. 1969 [T-MTT] (Special Issue on Microwave Acoustics)): 1045-1046.

Acoustic scattering parameters for the interdigital transducer are calculated as a function of electrical loading and frequency using an equivalent circuit model of the interdigital transducer. Measurements of the surface wave scattering parameters at 100 MHz are reported which are in close agreement with theory. Applications of the interdigital array as an efficient reflector of surface waves and as a weak low-reflecting tapping transducer are discussed.

Abstracts

Exact Solutions of Stepped Impedance Transformers Having Maximally Flat and Chebyshev Characteristics (Correction)

C.S. Gledhill. "Exact Solutions of Stepped Impedance Transformers Having Maximally Flat and Chebyshev Characteristics (Correction)." 1969 Transactions on Microwave Theory and Techniques 17.11 (Nov. 1969 [T-MTT] (Special Issue on Microwave Acoustics)): 1046-1046.

In (15) of the above paper, page 380, the term in the denominator outside the bracket should have read 2/spl radic/R.

Abstracts

Contributors (Nov. 1969 [T-MTT])

L.R. Adkins, J.M. Alsup, E.A. Ash, B.A. Auld, H.L. Bertoni, P.H. Carr, R.-S. Chu, J.H. Collins, I.N. Court, R.M. De La Rue, W.I. Dobrov, H.M. Gerard, H.V. Hance, F.S. Hickernell, A.J. Hughes, R.F. Humphryes, K.A. Ingebrigtsen, E.K. Kirchner, K.M. Lakin, A.A. Oliner, T.M. Reeder, G. Rupprecht, R.V. Schmidt, H.J. Shaw, A.B. Smith, W.R. Smith, W.D. Squire, R.F. Steinberg, E. Stern, T. Tamir, A. Tonning, F.W. Voltmer, R.A. Waldron, H.J. Whitehouse and D.K. Winslow. "Contributors (Nov. 1969 [T-MTT])." 1969 Transactions on Microwave Theory and Techniques 17.11 (Nov. 1969 [T-MTT] (Special Issue on Microwave Acoustics)): 1047-1051.

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Information for Authors (Nov. 1969 [T-MTT])

"Information for Authors (Nov. 1969 [T-MTT])." 1969 Transactions on Microwave Theory and Techniques 17.11 (Nov. 1969 [T-MTT] (Special Issue on Microwave Acoustics)): 1052-1052.

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International Microwave Symposium (Dec. 1969 [T-MTT])

J.B. Horton. "International Microwave Symposium (Dec. 1969 [T-MTT])." 1969 Transactions on Microwave Theory and Techniques 17.12 (Dec. 1969 [T-MTT]): 1054-1059.

The Dallas Chapter of the IEEE Group on Microwave Theory and Techniques hosted the 1969 IEEE G-MTT International Microwave Symposium, May 5-7, 1969, at the Marriott Motor Hotel, Dallas, Tex. This year's Symposium was highlighted by a greatly expanded and comprehensive technical program which included twelve sessions and three panel discussions. For the first time, parallel sessions were held in both the regular sessions and panel discussions, and late news items were included as a feature of the program. Ninety-six papers, including twelve late news items, were included in the program; eighteen panel members made up the three discussion panels. The expanded program resulted in a Symposium Digest of over 500 pages.

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Circuits for High-Efficiency Avalanche-Diode Oscillators (Dec. 1969 [T-MTT])

W.J. Evans. "Circuits for High-Efficiency Avalanche-Diode Oscillators (Dec. 1969 [T-MTT])." 1969 Transactions on Microwave Theory and Techniques 17.12 (Dec. 1969 [T-MTT]): 1060-1067.

This paper describes and analyzes the circuits which have been used successfully for TRAPATT oscillator studies. The results lead to a better understanding of the TRAPATT oscillator and yield a simple model of the oscillator which is useful for circuit design. The circuit characteristics of an experimental TRAPATT oscillator are determined from measurements on the circuits and from equivalent circuit model calculations. The following conclusions can be drawn from the analysis. First, the avalanche diode requires sufficient capacitance near the diode to sustain the high-current state required for TRAPATT operation. Secondly, at a distance from the diode corresponding to approximately one half-wavelength at the TRAPATT frequency the transmission line containing the diode should be terminated by a low-pass filter. The function of the filter is to pass the TRAPATT frequency and to provide a shorting plane for the harmonics of that frequency. Finally, on the load side of the filter, tuning for the TRAPATT frequency is required. The model of the circuit described above suggests a simple explanation of the diode-circuit interaction in a TRAPATT oscillator. Simplified waveforms suggested by the model have been used to calculate power out-put, efficiency, dc voltage change, and RF impedance for the oscillator. The results agree within a few percent with those obtained for an experimental oscillator. An important conclusion of the analysis is that the high-efficiency operation of avalanche diodes at frequencies in the UHF range can be explained by the TRAPATT theory, even though the trapped-plasma or low-voltage state may last only 1/20th of the oscillation period.

Abstracts

Microstrip High-Power High-Efficiency Avalanche-Diode Oscillator

S.-G. Liu. "Microstrip High-Power High-Efficiency Avalanche-Diode Oscillator." 1969 Transactions on Microwave Theory and Techniques 17.12 (Dec. 1969 [T-MTT]): 1068-1071.

A simple microstrip oscillator circuit has been designed and operated satisfactorily with high-power high-efficiency avalanche diodes. The power output obtained from a single diode chip is ahout 100 watts at 1 GHz with efficiencies of 25 to 30 percent. Mechanical tuning capability of a few hundred megahertz and a combined power output from series-connected diodes have been demonstrated using the circuit. An essential part of the circuit is a low-pass filter tuning section which enables the circuit to support high-order harmonics including the transit-time frequency and prevents them from getting to the load. Probe measurements of the electric field show strong second as well as third harmonics inside the circuit.

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A 4-GHz Multistage Transistor Amplifier

K. Ayaki, E. Igarashi and Y. Kajiwara. "A 4-GHz Multistage Transistor Amplifier." 1969 Transactions on Microwave Theory and Techniques 17.12 (Dec. 1969 [T-MTT]): 1072-1077.

Multistage microwave transistor amplifiers of simple construction have been developed. In these amplifiers, unit amplifiers of the same design are connected in cascade with short transmission lines inserted between each amplifier. The n-stage (three-, four-, five-, six-, and seven-stage) amplifiers designed for the 4-GHz band gave power gains n times that of the unit amplifier (4 dB) and flat bandwidths of about 1000 MHz. The stripline circuit of the amplifier is fabricated on alumina substrates in the usual way. The amplifier has the disadvantage of poor input and output impedance matching. However, this problem was solved by integrating isolators in the input and output ports of the multistage amplifier. Noise performance of the amplifier is also described.

Abstracts

The Design of Broad-Band Frequency Doublers Using Charge-Storage Diodes (Dec. 1969 [T-MTT])

K.L. Kotzebue and G.L. Matthaei. "The Design of Broad-Band Frequency Doublers Using Charge-Storage Diodes (Dec. 1969 [T-MTT])." 1969 Transactions on Microwave Theory and Techniques 17.12 (Dec. 1969 [T-MTT]): 1077-1086.

Many frequency multipliers can be viewed as consisting of an impedance inverter which couples together impedances at two different frequencies. Using this point of view, the design, construction, and evaluation of a five-resonator, broad-band frequency doubler employing charge-storage diodes is discussed. The doubler is a balanced design, employing two diodes and a balun. Design procedures which relate a low-pass filter prototype to the doubler circuit are presented. Good agreement between theory and experiment has been demonstrated; the experimental doubler exhibits approximately an octave bandwidth at 50 percent efficiency with an input frequency range of 1 to 2 GHz.

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Coplanar Waveguide: A Surface Strip Transmission Line Suitable for Nonreciprocal Gyromagnetic Device Applications (Dec. 1969 [T-MTT])

C.P. Wen. "Coplanar Waveguide: A Surface Strip Transmission Line Suitable for Nonreciprocal Gyromagnetic Device Applications (Dec. 1969 [T-MTT])." 1969 Transactions on Microwave Theory and Techniques 17.12 (Dec. 1969 [T-MTT]): 1087-1090.

A coplanar waveguide consists of a strip of thin metallic film on the surface of a dielectric slab with two ground electrodes running adjacent and parallel to the strip. This novel transmission line readily lends itself to nonreciprocal magnetic device applications because of the built-in circularly polarized magnetic vector at the air-dielectric boundary between the conductors. Practical applications of the coplanar waveguide have been experimentally demonstrated by measurements on resonant isolators and differential phase shifters fabricated on low-loss dielectric substrates with high dielectric constants. Calculations have been made for the characteristic impedance, phase velocity, and ripper bound of attenuation of a transmission line whose electrodes are all on one side of a dielectric substrate. These calculations are in good agreement with preliminary experimental results. The coplanar configuration of the transmission system not only permits easy shunt connection of external elements in hybrid integrated circuits, but also adapts well to the fabrication of monolithic integrated systems. Low-loss dielectric substrates with high dielectric constants may be employed to reduce the longitudinal dimension of the integrated circuits because the characteristic impedance of the coplanar waveguide is relatively independent of the substrate thickness; this may be of vital importance for low-frequency integrated microwave systems.

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Slot Line Characteristics

E.A. Mariani, C.P. Heinzman, J.P. Agrios and S.B. Cohn. "Slot Line Characteristics." 1969 Transactions on Microwave Theory and Techniques 17.12 (Dec. 1969 [T-MTT]): 1091-1096.

The slot line, a novel transmission line suitable for application to microwave integrated circuits, may be used in place of or in association with microstrip. This paper presents experimental and theoretical data concerning slot line wavelength, characteristic impedance, transitions, and tolerances. The measurements have been conducted at S band using different dielectric constant materials. Experimental results indicate that the slot wavelength /spl lambda/ agrees with theory to within 2 percent, whereas the characteristic impedance of the slot line was measured to be about 30 percent less than the theoretical value. Tolerances associated with the theoretical slot line parameters were not found to be critical.

Abstracts

Slot Line Application to Miniature Ferrite Devices

G.H. Robinson and J.L. Allen. "Slot Line Application to Miniature Ferrite Devices." 1969 Transactions on Microwave Theory and Techniques 17.12 (Dec. 1969 [T-MTT]): 1097-1101.

This paper presents preliminary results and conclusions of experimental investigation of the potential usefulness of slot transmission line. Measurement of phase constant, insertion loss, and other general characteristics are presented and compared with theoretical predictions. Transitions from slot to coax and slot to microstrip are described.One of the more interesting characteristics of slot line, the existence of an elliptically polarized H field, is applied in planar ferrite phase shifter design. Experimental data are presented including preliminary latched phase shift results.

Abstracts

The Half-Wave Stepped Digital Elliptic Filter

J.D. Rhodes. "The Half-Wave Stepped Digital Elliptic Filter." 1969 Transactions on Microwave Theory and Techniques 17.12 (Dec. 1969 [T-MTT]): 1102-1107.

A design procedure for narrow-band bandpass TEM-line elliptic-function filters is presented. The proposed realization is in the form of a stepped-impedance digital n-wire line which is one-half of a wavelength long at midband and short circuited to ground at both ends, where the digital line is stepped in impedance along any arbitrary prescribed plane in the filter. Due to its physical form and mode of electrical operation, the filter has been termed the half-wave stepped digital elliptic filter. A detailed design procedure for the construction of the two characteristic admittance matrices which describe the digital n-wire line from the low-pass prototype element values is presented. It is also shown that the normalized impedance values of the elements in the filter are all of the order of unity and independent of the actual bandwidth of the falter except for the input and output transformer elements. A numerical example and experimental results on a seventh-degree 1-percent bandwidth filter with a center frequency at 3.7 GHz are given, demonstrating the significant improvements which may be obtained from the half-wave stepped digital elliptic filter over most other known form of microwave TEM-line narrow-band bandpass filter.

Abstracts

Narrow-Bandwidth Elliptic-Function Filters

I. Rubinstein, R.L. Sleven and A.F. Hinte. "Narrow-Bandwidth Elliptic-Function Filters." 1969 Transactions on Microwave Theory and Techniques 17.12 (Dec. 1969 [T-MTT]): 1108-1115.

This paper describes the development of a practical circuit for realizing narrow-bandwidth elliptic-function filters at microwave frequencies. The design procedure is presented for TEM filters of any bandwidth up to about 10 percent. Experimental verification of the low-loss feature of the elliptic-function response is demonstrated with measured data on 1-percent-bandwidth strip-transmission-line S-band filters.

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Design of Commensurate Transmission-Line Circuits (Dec. 1969 [T-MTT])

W. Steenaart and R.J. Murphy. "Design of Commensurate Transmission-Line Circuits (Dec. 1969 [T-MTT])." 1969 Transactions on Microwave Theory and Techniques 17.12 (Dec. 1969 [T-MTT]): 1115-1122.

Digital computer techniques are developed for the approximation of the periodic frequency characteristics of commensurate transmission-line circuits. For a given periodic delay or loss-derivative function the system function is derived automatically rising a direct method. Any suitable synthesis program will complete the design.

Abstracts

Quasi-Optical Low-Pass Filters which Attenuate by Absorption (Dec. 1969 [T-MTT])

G.L. Matthaei and D.A. Leedom. "Quasi-Optical Low-Pass Filters which Attenuate by Absorption (Dec. 1969 [T-MTT])." 1969 Transactions on Microwave Theory and Techniques 17.12 (Dec. 1969 [T-MTT]): 1123-1129.

A type of filter structure is discussed which has application for quasi-optical systems using focused beams or oversized waveguide. The filter structure consists of a number of focusing reflectors which in the passband of the filter focus the energy from one reflector to the next so that the energy is beamed in a zig-zag fashion. However, the focusing reflectors are made from arrays of spaced-apart metal plates with the edges of the plates parallel to the E field. The focusing face of each reflector is thus formed by the front edges of the plates. When the frequency is suffciently high so that the spacing between the plates is greater than a half-wavelength, the energy passes between the plates and is absorbed by dissipative material placed therein. Thus above a certain frequency the reflectors are absorptive and a stopband is formed. A trial three-reflector structure was fabricated and tested with very encouraging results. The minimum loss points in the passband were about 1 dB, and the stopband was broad and free from spurious responses. There were 3- or 4-dB attenuation spikes in the passband due to "trapped modes," but it should be possible to eliminate these by improved mode launchers.

Abstracts

Asymptotic Expressions for Eigenfunctions and Eigenvalues of a Dielectric or Optical Waveguide

A.W. Snyder. "Asymptotic Expressions for Eigenfunctions and Eigenvalues of a Dielectric or Optical Waveguide." 1969 Transactions on Microwave Theory and Techniques 17.12 (Dec. 1969 [T-MTT]): 1130-1138.

An asymptotic technique is presented, resulting in an analytically simple self-consistent description of the modes of a circular dielectric structure. When the dielectric difference between the rod and surrounding medium is small, the asymptotic expressions are valid for all frequencies. Even when the inside dielectric constant is twice the outside, less than a 10 percent error is usually involved. A simple functional expression for the eigenvalues of both the circular rod and the dielectric slab results from the analysis, thus eliminating the need for numerical or graphical methods.

Abstracts

Excitation and Scattering of Modes on a Dielectric or Optical Fiber

A.W. Snyder. "Excitation and Scattering of Modes on a Dielectric or Optical Fiber." 1969 Transactions on Microwave Theory and Techniques 17.12 (Dec. 1969 [T-MTT]): 1138-1144.

A technique similar to that of Kirchhoff is used to obtain an analytic expression for mode launching on a semi-infinite rod. The approximation is quasi-optical and only valid for small angles of incidence /spl theta/. When /spl theta/ = 0 only HE/sub 1M/ modes are excited; however, for /spl theta/<<1 many modes can be launched. The effect on HE/sub 11/ mode propagation of small imperfections in a dielectric waveguide is analyzed. At the frequency of interest for optical communication (cutoff for the TM/sub 01/ mode) the radiated power is 160 times larger than that scattered into the HE/sub 11/ mode.

Abstracts

A 94-GHz Radar for Space Object Identification (Dec. 1969 [T-MTT])

L.A. Hoffman, K.H. Hurlbut, D.E. Kind and H.J. Wintroub. "A 94-GHz Radar for Space Object Identification (Dec. 1969 [T-MTT])." 1969 Transactions on Microwave Theory and Techniques 17.12 (Dec. 1969 [T-MTT]): 1145-1149.

A feasibility demonstration radar system that operates at 94 GHz is outlined. A major goal of the program is the obtaining of radar echoes from orbiting objects for space object identification purposes. The radar is a linear FM pulse compression system with an eventual pulse time (1 ms)-bandwidth (1 GHz) product of 10/sup 6/. Experimental results of short range tests are discussed as well as details of the phase-locked loop linearizing system employed.

Abstracts

Interdigitated Stripline Quadrature Hybrid (Correspondence)

J. Lange. "Interdigitated Stripline Quadrature Hybrid (Correspondence)." 1969 Transactions on Microwave Theory and Techniques 17.12 (Dec. 1969 [T-MTT]): 1150-1151.

Interdigitated microstrip couplers consist of three or more parallel striplines with alternate lines tied together. A single ground plane, a single dielectric, and a single layer of metallization are used. Thus the approach is eminently suited for monolithic or hybrid thin-film microwave integrated circuitry. Tight coupling is achieved much more easily than with noninterdigitated edge-coupled lines. Fabrication and tolerance problems make it almost impossible to build noninterdigitated 3-dB edge couplers. Also, current crowding at the edges, which can result in high loss, is much less severe for the interdigitated coupler. Previously, tight coupling in directional couplers for microwave integrated circuits has been achieved by broadside coupling, reentrant sections, tandem sections, or branch-line couplers. Some of the disadvantages of these approaches are narrow bandwidth, large substrate area, and the need for multilayer circuitry. A 3dB directional coupler (quadrature hybrid) for S band has been fabricated in microstrip on 40-mil alumina. A single quarter-wave section was used. The hybrid showed a directivity of over 27 dB, a return loss of over 25 dB, an insertion loss of less than 0.13 dB, and an imbalance of less than 0.25 dB over a 40 percent bandwidth.

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VHF- and UHF-Band Stacked-Junction Circulators (Correspondence)

S. Okamura and T. Nagai. "VHF- and UHF-Band Stacked-Junction Circulators (Correspondence)." 1969 Transactions on Microwave Theory and Techniques 17.12 (Dec. 1969 [T-MTT]): 1151-1152.

The stacked-junction circulator, in which two ordinary ferrite-loaded junctions are stacked and assembled in a common housing, is described. A UHF-band stripline stacked circulator and a VHF-band lumped-element stacked one have been constructed and proved to be effective in improving the cost to power performance.

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Thin-Film Lumped-Element Circulator (Correspondence)

R.H. Knerr. "Thin-Film Lumped-Element Circulator (Correspondence)." 1969 Transactions on Microwave Theory and Techniques 17.12 (Dec. 1969 [T-MTT]): 1152-1154.

A photolithographically produced lumped-element circulator is described. Complete physical and electrical symmetry is assured by interweaving the junction conductors using either dielectricor air crossovers and by employing symmetrically configured interdigital capacitors. Series resonant matching circuits compatible with photoetching techniques are proposed. The device is designed for operation at fields below the field for gyromagnetic resonance so that all of the circulator elements, as well as connecting circuitry, may be generated on the ferrite as a substrate without the necessity of magnetizing the entire substrate. This approach, which is applicable to any stripline configuration, makes it feasible to produce lumped element circulators for microwave integrated circuits at frequencies well above the range for previously reported lumped-element devices consisting of an assemblage of discrete components.

Abstracts

An All-Transistor 1-kW High-Gain UHF Power Amplifier (Correspondence)

R.L. Bailey, W.P. Bennett, L.F. Heckman and I.E. Martin. "An All-Transistor 1-kW High-Gain UHF Power Amplifier (Correspondence)." 1969 Transactions on Microwave Theory and Techniques 17.12 (Dec. 1969 [T-MTT]): 1154-1156.

A power amplifier in which the outputs of 64 RCA type 2N5016 overlay transistors are combined to provide a total CW output power of 1 kW at 400 MHz is described. A concept is employed wherein several transistors are connected in parallel to first form a power module, and then the outputs of a number of modules are combined in a Wilkinson N-way hybrid power combiner. This combiner has built-in isolation between each of the N input terminals. An identical N-way hybrid is employed as a power divider providing equal distribution of driving signal to each of the power modules. An overall power gain of 33 dB is achieved by providing additional transistor stages of preamplification. CW and pulse performance of the amplifier is described. Performance of the amplifier as the driver for a high-power tetrode tube is reported.

Abstracts

A Multiple-Diode High-Average-Power Avalanche-Diode Oscillator (Correspondence)

C.T. Rucker. "A Multiple-Diode High-Average-Power Avalanche-Diode Oscillator (Correspondence)." 1969 Transactions on Microwave Theory and Techniques 17.12 (Dec. 1969 [T-MTT]): 1156-1158.

This correspondence presents a simple circuit which allows direct combining of the power obtainable from several avalanche diodes. The circuit does not require extremely close matching of dc or RF diode characteristics, and no particular isolating networks such as hybrid combiners are necessary. CW power output exceeding 4 watts at 7 GHz and 3 watts at 9 GHz has been demonstrated in a device employing five diodes. The number of diodes which can be combined using this technique is limited by geometric and heat sink considerations. Descriptions of typical single-diode and multiple-diode oscillators are given along with equivalent circuits. The circuits employ resistors or resistor networks to suppress low-frequency oscillations and undesired resonances which occur when several oscillators are coupled together. Negligible insertion loss is incurred at the design output frequency. Measured performance is given on similar single- and multiple-diode oscillators. Data include frequency, power, AM noise, FM noise, temperature, and loaded Q.

Abstracts

CW Gunn Diodes in Composite Structure (Correspondence)

S. Mitsui. "CW Gunn Diodes in Composite Structure (Correspondence)." 1969 Transactions on Microwave Theory and Techniques 17.12 (Dec. 1969 [T-MTT]): 1158-1160.

Parallel combinations of Gunn diodes for X-band are fabricated with three types of n-type GaAs crystals. The diodes are mesa structured and mounted upside down on a copper stud of a package in parallel combination. An output power of 450 mW in CW operation at an efficiency of 2.9 percent is obtained in a double-mounted diode at 9 GHz.

Abstracts

Design Parameters for Overdriven Varactor Frequency Doublers Using Punch-Through or Bi-Mode Varactors (Correction)

A.I. Grayzel. "Design Parameters for Overdriven Varactor Frequency Doublers Using Punch-Through or Bi-Mode Varactors (Correction)." 1969 Transactions on Microwave Theory and Techniques 17.12 (Dec. 1969 [T-MTT]): 1160-1160.

The first sentence of the first paragraph should have read: "for a doubler when gamma = 0."

Abstracts

Contributors (Dec. 1969 [T-MTT])

J.P. Agrios, J.L. Allen, K. Ayaki, S.B. Cohn, W.J. Evans, C.P. Heinzman, A.F. Hinte, L.A. Hoffman, K.H. Hurlbut, E. Igarashi, Y. Kajiwara, D.E. Kind, K.L. Kotzebue, D.A. Leedom, S.-G. Liu, E.A. Mariani, G.L. Matthaei, R.J. Murphy, J.D. Rhodes, G.H. Robinson, I. Rubinstein, R.L. Sleven, A.W. Snyder, W. Steenaart, C.P. Wen and H.J. Wintroub. "Contributors (Dec. 1969 [T-MTT])." 1969 Transactions on Microwave Theory and Techniques 17.12 (Dec. 1969 [T-MTT]): 1161-1164.

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Index, IEEE Transactions on Microwave Theory and Techniques, Volume MTT-17, 1969

"Index, IEEE Transactions on Microwave Theory and Techniques, Volume MTT-17, 1969." 1969 Transactions on Microwave Theory and Techniques 17.12 (Dec. 1969 [T-MTT]): i-xii.

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Abstracts

Analysis and Design of a Microwave Transistor Active Filter

R.V. Snyder, Jr. and D.L. Bozarth. "Analysis and Design of a Microwave Transistor Active Filter." 1970 Transactions on Microwave Theory and Techniques 18.1 (Jan. 1970 [T-MTT]): 2-9.

In this paper "inverted common collector" transistor resonator filters will be analyzed. Simple formulas will be presented for the input immittance parameters, in terms of the bridged-T equivalent network and in terms of the common-emitter Y parameters. A design procedure is suggested, and a design example given. Stability of the resultant circuitry is discussed.

Abstracts

H Guide with Laminated Dielectric Slab

F.J. Tischer. "H Guide with Laminated Dielectric Slab." 1970 Transactions on Microwave Theory and Techniques 18.1 (Jan. 1970 [T-MTT]): 9-15.

A consideration of the field distribution and the characteristics of an H guide with a laminated dielectric bar composed of an arbitrary number of dielectric strips separated by air layers is presented. Low-loss wave modes with the electric field intensity predominantly parallel to the sidewalls are analyzed. Approximate thin-layer equations are derived which indicate methods for improvements of the attenuation of the H guide.

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Microwave Networks with Equiripple Delay Characteristics

S.O. Scanlan and T.P. Pantzaris. "Microwave Networks with Equiripple Delay Characteristics." 1970 Transactions on Microwave Theory and Techniques 18.1 (Jan. 1970 [T-MTT]): 15-25.

The problem of finding a characteristic polynomial to provide equiripple delay characteristics in commensurate TEM microwave networks is solved numerically. These polynomials enable the synthesis of such filters in the form of cascaded transmission lines or in the form of stub filters to be undertaken. Results for the orders 2 through 6 are presented. The synthesis of constant delay all-pass networks can also be performed and the method for doing so is presented. The attenuation characteristic corresponding to the equiripple delay filter does not, of course, possess a sharp cutoff, since these filters are of the minimum phase type.

Abstracts

Computer-Aided Design of Three-Port Waveguide Junction Circulators

J.B. Castillo, Jr. and L.E. Davis. "Computer-Aided Design of Three-Port Waveguide Junction Circulators." 1970 Transactions on Microwave Theory and Techniques 18.1 (Jan. 1970 [T-MTT]): 25-34.

The complete performance of a lossless three-port H-plane waveguide junction loaded coaxially with various inhomogeneous ferrite cylanders has been evaluated over the waveguide bandwidth and compared with experiment. Qualitative agreement between the predicted and measured performance was generally good using only the first three modes, n=0±1. It has been shown theoretically and verified experimentally that if the 4 pi M/sub s/ of a homogeneous rod or the internal field is increased, the circulation frequency f/sub 0/ increases; conversely, if the pemittivity is increased, f/sub 0/ decreases. These conflicting effects are modified when the magnetization 4 pi M/sub s/ and permittivity epsilon are inhomogeneous. For example, if the 4piM/sub s/(gamma) is small at the outer surface of the rod (with permittivity held constant), the effect on f/sub 0/ is very small; but if 4piM/sub s/(gamma) approaches zero for gamma small, then f/sub 0/ may decrease significantly. On the other hand, if epsilon/sub gamma/(gamma) approaches unity near the outer surface of the rod, f/sub 0/ may increase significantly; but if epsilon/sub gamma/(gamma) approaches unity near the center of the rod, f/sub 0/ is affected relatively little. The inhomogeneous structure has also shown that decreasing the ferrite volume may improve the performance, and high-power applications are suggested. With a conducting pin down the center of the ferrite, relative bandwidths of 40-50 percent are predicted.

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Calculation of Coefficients of Capacitance of Multiconductor Transmission Lines in the Presence of a Dielectric Interface

W.T. Weeks. "Calculation of Coefficients of Capacitance of Multiconductor Transmission Lines in the Presence of a Dielectric Interface." 1970 Transactions on Microwave Theory and Techniques 18.1 (Jan. 1970 [T-MTT]): 35-43.

A method is given for the numerical determination of the coefficients of capacitance for a class of multiconductor transmission-line systems. This class includes systems without ground planes, or with one or two ground planes, with the lines embedded in one or two layers of dielectrics. The conductors can be of any cross section that can be approximated adequately by polygons. The method is a refinement of the subareas method in which the assumption of a "staircase function" surface charge density, that is, constant charge density over each subarea, is replaced by the assumption of a piecewise linear charge density over the conductor surfaces, and the charge density parameters are determined by making a least-squares fit to the potential to the boundary conditions of the problem.

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Varactor-Tuned Avalanche Transit-Time Oscillator with Linear Tuning Characteristics (Correspondence)

M.I. Grace. "Varactor-Tuned Avalanche Transit-Time Oscillator with Linear Tuning Characteristics (Correspondence)." 1970 Transactions on Microwave Theory and Techniques 18.1 (Jan. 1970 [T-MTT]): 44-45.

A circuit is described which uses an abrupt junction varactor to electronically tune an IMPATT oscillator. Linear voltage frequency tuning is obtained over a 10 percent frequency band.

Abstracts

Small Analog Stripline X-Band Ferrite Phase Shifter (Correspondence)

T. Nelson, R.A. Moore, E. Wantuch, D. Buck, R. Huber and R. Lee. "Small Analog Stripline X-Band Ferrite Phase Shifter (Correspondence)." 1970 Transactions on Microwave Theory and Techniques 18.1 (Jan. 1970 [T-MTT]): 45-46.

A small analog X-band stripline phase shifter using commercially available ferrites provides a figure of merit of 300° /dB, average coil drive power of 30 mW and element weight less than 4 oz. Experiments on an element using a new zinc-doped magnesium-manganese ferrite have given a figure of merit of 450° /dB.

Abstracts

Synthesis of Symmetrical Branch-Guide Directional Couplers (Comments)

H.J. Riblet. "Synthesis of Symmetrical Branch-Guide Directional Couplers (Comments)." 1970 Transactions on Microwave Theory and Techniques 18.1 (Jan. 1970 [T-MTT]): 47-48.

This note considers the approximation problem encountered in the synthesis of branch-guide couplers. An alternate solution to that proposed by R. Levy and L.F. Lind is considered and shown to give generally inferior performance. It is inferred then, that an important design criterion is the requirement that the passband of the coupler contains the maximum number of frequencies of perfect match consistent with elements that are a quarter-wave-length long at midband.

Abstracts

Intermodulation Product and Switching Noise Amplitudes of a p-i-n Diode Switch in the UHF Band (Correspondence)

R.L. Sicotte and R.N. Assaly. "Intermodulation Product and Switching Noise Amplitudes of a p-i-n Diode Switch in the UHF Band (Correspondence)." 1970 Transactions on Microwave Theory and Techniques 18.1 (Jan. 1970 [T-MTT]): 48-50.

This correspondence describes some measurements of intermodulation product and switching noise amplitudes at UHF in a p-i-n diode switch.

Abstracts

The Junction Inductance of a Lumped-Constant Circulator (Correspondence)

J. Helszajn and M. McDermott. "The Junction Inductance of a Lumped-Constant Circulator (Correspondence)." 1970 Transactions on Microwave Theory and Techniques 18.1 (Jan. 1970 [T-MTT]): 50-52.

One form of the lumped-constant circulator consists of a mesh arrangement of three short-circuited striplines arranged at 120° which are insulated from each other. If the mesh arrangements are electrically short the energy within the disk geometry is essentially magnetic. In this correspondence the inductance associated with this magnetic energy is calculated by forming the input impedance of the mesh. Because of the geometry used the characteristic impedance and phase velocity of this transmission line are those associated with the even-mode excitation of two coupled lines. Graphical results are given for both the stripline and microstrip cases.

Abstracts

New Design Technique for Stable Wide-Band Tunnel-Diode Amplifier (Correspondence)

K. Shirahata and D. Taketomi. "New Design Technique for Stable Wide-Band Tunnel-Diode Amplifier (Correspondence)." 1970 Transactions on Microwave Theory and Techniques 18.1 (Jan. 1970 [T-MTT]): 52-54.

It is verified experimentally and theoretically that highly reflective out-of-band characteristics are inherent in the usual stripline circulator, and follow a certain regularity. It is then described how a small-sized additional network to the circulator can improve its out-of-band characteristics. Using the improved circulator with this network, it is shown how to design a small-size wide-band TDA.

Abstracts

Wood Anomalies in Diffraction from Strip Grating (Correspondence)

T. Itoh and R. Mittra. "Wood Anomalies in Diffraction from Strip Grating (Correspondence)." 1970 Transactions on Microwave Theory and Techniques 18.1 (Jan. 1970 [T-MTT]): 54-55.

In this correspondence, numerical calculations have been carried out for the reflection and transmission coefficients of various order fields scattered from strip gratings. The work is based on an integral equation formulation followed by Galerkin's method of solution. The results exhibit the occurrence of Wood anomalies at the so-called Rayleigh wavelengths.

Abstracts

Even and Odd Mode Impedance of Coupled Pairs of Microstrip Lines (Correspondence)

W.H. Chen. "Even and Odd Mode Impedance of Coupled Pairs of Microstrip Lines (Correspondence)." 1970 Transactions on Microwave Theory and Techniques 18.1 (Jan. 1970 [T-MTT]): 55-57.

Even mode impedances of coupled pairs of microstrip lines have been computed, and corresponding odd mode impedances have been empirically estimated. The analysis is based on the superposition of solutions for single rnicrostrip lines.

Abstracts

A New Type of Quasi-Optical Waveguide Component (Correspondence)

J.W. Carson. "A New Type of Quasi-Optical Waveguide Component (Correspondence)." 1970 Transactions on Microwave Theory and Techniques 18.1 (Jan. 1970 [T-MTT]): 57-58.

A new form of quasi-optical waveguide component has been designed that is based on use of the Brewster angle and on the rapid variation of reflectance and change of phase near the critical angle. An attenuator was built in S-band waveguide and its performance measured at 35 and 94 GHz. Diffraction is the limiting factor on the device operation, so practical device applications will likely be limited to 1-mm wavelengths and less.

Abstracts

Broad-Band High IF Mixers Based on Magic T's (Correspondence)

C.P. Tresselt. "Broad-Band High IF Mixers Based on Magic T's (Correspondence)." 1970 Transactions on Microwave Theory and Techniques 18.1 (Jan. 1970 [T-MTT]): 58-60.

This correspondence describes the design of a high intermediate frequency mixer based on the use of a broad-band stripline magic T. Advantages of the design include the ability to process RF signals down to the upper IF band edge without diplexer crossover loss. Experimental results are presented.

Abstracts

Minimum Principle Determination of Equivalent Parameters of Microwave Structures (Correspondence)

K. Kalikstein and C.J. Kleinman. "Minimum Principle Determination of Equivalent Parameters of Microwave Structures (Correspondence)." 1970 Transactions on Microwave Theory and Techniques 18.1 (Jan. 1970 [T-MTT]): 60-61.

A variational bound (minimum) principle originally introduced in quantum mechanical scattering problems is here adapted to the scattering of electromagnetic waves by a nonsymmetric obstacle in a rectangular waveguide. Numerical results are given for a simple case.

Abstracts

Millimeter-Wave Directional Filter (Correspondence)

S. Shimada, I. Ootomo, S. Ishii, K. Ohi and H. Hirotani. "Millimeter-Wave Directional Filter (Correspondence)." 1970 Transactions on Microwave Theory and Techniques 18.1 (Jan. 1970 [T-MTT]): 61-62.

This correspondence describes experimental results in the 50-GHz band on one-resonator and two-resonator maximally flat directional filters. The center frequencies of these filters can be smoothly changed over a wide range by means of two kinds of novel tuning mechanisms.

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Modes and Pseudomodes in Dielectric Waveguides (Correspondence)

D. Marcuse. "Modes and Pseudomodes in Dielectric Waveguides (Correspondence)." 1970 Transactions on Microwave Theory and Techniques 18.1 (Jan. 1970 [T-MTT]): 62-63.

It is shown that a medium whose dielectric constant has a square-law distribution with complex coefficients possesses guided mode solutions even under the extreme condition that both the real and the imaginary part of the index of refraction have their lowest value at the axis of the waveguide. However, the resulting modes are unstable (pseudomodes). Stable guided modes exist if the imaginary part of the refractive index has its highest value on axis.

Abstracts

Biharmonic Operators for the Waveguide Problem (Correspondence)

P. Silvester. "Biharmonic Operators for the Waveguide Problem (Correspondence)." 1970 Transactions on Microwave Theory and Techniques 18.1 (Jan. 1970 [T-MTT]): 63-64.

The inverse iteration method of analyzing an isotropic waveguide is reexamined with a view to finding the higher order modes. It is shown that the problem may be formulated in terms of a generalized biharmonic operator, which is always at least semidefinite. Several finite-difference representations are given for this operator. Of these, two possess property A, a point of fundamental importance for iterative solution by successive overrelaxation.

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Abstracts

A Plasma Video Detector (Correspondence)

D.C. McCain. "A Plasma Video Detector (Correspondence)." 1970 Transactions on Microwave Theory and Techniques 18.1 (Jan. 1970 [T-MTT]): 64-65.

A low-noise microwave detector has been developed for use with high CW carrier power and low modulation frequency. Under some conditions, the sensitivity and noise temperature of this device are better than those exhibited by the best crystal video detectors.

Abstracts

Characteristic Impedance of Microstrip by the Method of Moments (Correspondence)

A. Farrar and A.T. Adams. "Characteristic Impedance of Microstrip by the Method of Moments (Correspondence)." 1970 Transactions on Microwave Theory and Techniques 18.1 (Jan. 1970 [T-MTT]): 65-66.

The "method of moments" is used to calculate the capacity per unit length of a microstrip transmission line. The characteristic impedance is obtained by assuming TEM mode of propagation. The values of the impedance calculated by this method are in good agreement with the results reported by Wheeler and Sobol.

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Guided Waves in a Class of Stripline and Other Parallel-Plate Structures (Correspondence)

R.E. Eaves, Jr. and D.M. Bolle. "Guided Waves in a Class of Stripline and Other Parallel-Plate Structures (Correspondence)." 1970 Transactions on Microwave Theory and Techniques 18.1 (Jan. 1970 [T-MTT]): 66-68.

The dominant mode of the open-sided shielded stripline is TEM and has rightly received considerable attention. Few analyses of its non-TEM properties are available. Oliner and Samuilov have assumed the existence of higher order modes and calculated cutoff frequencies through a transverse resonance approach. Brackelmann et al. have made computations through series-matching, and report that non-TEM modes do not exist for open-sided shielded stripline. Bolle and Eaves, through a Wiener-Hopf technique, have made calculations that substantiate this. Ilenborg and Pregla have made calculations through series matching for a stripline of two strips and report H modes. However, such numerical results allow strict conclusions only for the specific parameters chosen, and, furthermore, the conclusions are subject to computational error. These practical considerations along with the aesthetic make a non-numerical investigation desirable. It will be shown that the shielded stripline, and indeed a general class of parallel-plate waveguide structures, do not support non-TEM modes.

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Ferromagnetic Resonance in Planar Ferrites (Correspondence)

L.M. Silber. "Ferromagnetic Resonance in Planar Ferrites (Correspondence)." 1970 Transactions on Microwave Theory and Techniques 18.1 (Jan. 1970 [T-MTT]): 68-68.

Attention is called to the fact that most planar ferrites are not adequately described by a single crystalline anisotropy constant. The presence of higher order terms in the anisotropy is important if resonance with the static field out of the easy plane is considered.

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Abstracts

An Orthogonal Coordinate System for Curved Pipes (Correspondence)

C.H. Tang. "An Orthogonal Coordinate System for Curved Pipes (Correspondence)." 1970 Transactions on Microwave Theory and Techniques 18.1 (Jan. 1970 [T-MTT]): 69-69.

To facilitate the study of wave propagation along curved structures, such as curved waveguides and antennas, it is desirable to have an orthogonal coordinate system for an arbitrary smooth curve. Such a coordinate system can be derived from the Serret-Frenet frame of the curve.

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Phase Characteristics of a Circularly Symmetric Dual-Mode Transducer (Correspondence)

K.K. Agarwal and E.R. Nagelberg. "Phase Characteristics of a Circularly Symmetric Dual-Mode Transducer (Correspondence)." 1970 Transactions on Microwave Theory and Techniques 18.1 (Jan. 1970 [T-MTT]): 69-71.

This correspondence deals with the analysis and measurement of TE/sub 11/° --> TM/sub 11/° mode conversion by circularly symmetric transducers in a circular waveguide. Two types are considered, the simple step change in radius and a discontinuity covered by a dielectric ring. For the first type, experimental results for both amplitude and phase are compared with predictions made on the basis of a computer program, with excellent agreement. The dielectric loaded transducer is of great interest since measurements have shown that such a device can be designed to launch the two modes with a relative amplitude and phase which is essentially independent of frequency over a very wide range. This configuration is therefore an excellent candidate for use in low-noise microwave antenna systems.

Abstracts

Power Combiner Nomograms (Correspondence)

F.E. Gardiol. "Power Combiner Nomograms (Correspondence)." 1970 Transactions on Microwave Theory and Techniques 18.1 (Jan. 1970 [T-MTT]): 71-72.

A set of three nomograms yields directly the phase and amplitude of the output signal in terms of the two input signals for an ideal and symmetric hybrid combiner.

Abstracts

Thin Skin IMPATTS (Correspondence)

B.C. De Loach, Jr.. "Thin Skin IMPATTS (Correspondence)." 1970 Transactions on Microwave Theory and Techniques 18.1 (Jan. 1970 [T-MTT]): 72-74.

This correspondence summarizes some consequences of "skin effect" for high-frequency IMPATT diodes. The enormous current densities, well in excess of 10/sup 5/ A/cm², currently employed in high-frequency IMPATT diodes are shown to cause nonuniform current distributions due to skin effect in diodes of conventional dimensions. These nonuniformities in turn preclude high efficiency. They also provide an explanation for the small increase in output power attained in pulse operation, in which even higher current densities are experienced than in CW operation. Practical means of reducing these effects exist within semiconductor technology and are briefly discussed.

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D.L. Bozarth, J.B. Castillo, Jr., L.E. Davis, T.P. Pantzaris, S.O. Scanlan, R.V. Snyder, F.J. Tischer and W.T. Weeks. "Contributors (Jan. 1970 [T-MTT])." 1970 Transactions on Microwave Theory and Techniques 18.1 (Jan. 1970 [T-MTT]): 75-75.

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Information on Computer Program Descriptions (Jan. 1970 [T-MTT])

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An Analytical Method for Calculating Microstrip Transmission Line Parameters

S.V. Judd, I. Whiteley, R.J. Clowes and D.C. Rickard. "An Analytical Method for Calculating Microstrip Transmission Line Parameters." 1970 Transactions on Microwave Theory and Techniques 18.2 (Feb. 1970 [T-MTT]): 78-87.

When finite difference techniques are applied to the solution of coupled-line parameters for microstrip transmission lines, the computation times become prohibitively long. This paper describes an analytical method for calculating such parameters if TEM propagation is assumed. The method is applicable to a wide range of planar TEM mode transmission line calculations where the boundaries and dielectric interfaces are rectilinear. The accuracy of the analytical technique has been verified by experimental work on 10 dB and 6 dB coupled-line directional couplers and a parallel-coupled Cohn type 6 resonator filter.

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Longitudinal Section Mode Analysis of Dielectrically Loaded Rectangular Waveguides with Application to Phase Shifter Design

G.N. Tsandoulas, D.H. Temme and F.G. Willwerth. "Longitudinal Section Mode Analysis of Dielectrically Loaded Rectangular Waveguides with Application to Phase Shifter Design." 1970 Transactions on Microwave Theory and Techniques 18.2 (Feb. 1970 [T-MTT]): 88-95.

The structure consisting of an E-plane dielectric slab partially filling a rectangular waveguide is examined with attention on those higher order mode propagation characteristics that are relevant to the design of nonreciprocal remanence ferrite phase shifters. The validity of the model is established by introducing experimental comparison in the form of VSWR measurements for both pure dielectric loading and an actual composite ferrite phase shifter. Emphasis is placed on the consideration of possible mechanisms for the elimination of LSE/sub 11/, LSM/sub 11/, and LSE/sub 12/ modes, since certainly the first, most probably the second, and quite possibly the third will propagate in a practical device. Experimental verification of theoretical predictions is established and phaser design guidelines are drawn. Some additional topics, such as slabcorner chamfering and the effect of the switching wire, are included for completeness.

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Numerical Data Processing of Reflection Coefficient Circles

D. Kajfez. "Numerical Data Processing of Reflection Coefficient Circles." 1970 Transactions on Microwave Theory and Techniques 18.2 (Feb. 1970 [T-MTT]): 96-100.

A numerical procedure is described for processing the data of a microwave measurement in which the measured points are distributed in a form of a circle in a complex plane. Instead of plotting the measured data on a Smith chart and analyzing them by graphical methods, the data are analyzed by the method of least squares. The result of this analysis consists of three complex numbers K, L, and M, which define the bilinear transformation in question. The procedure is illustrated on the example of impedance versus bias measurements on a varactor diode which was recently described by E. W. Sard. The necessary formulas are derived for computation of elements of the equivalent circuit from the above constants K, L, and M. The procedure is well-suited for programming a digital computer.

Abstracts

Equivalent Circuit of Orthogonal-Loop-Coupled Magnetic Resonance Filters and Bandwidth Narrowing Due to Coupling Inductance

P.S. Carter. "Equivalent Circuit of Orthogonal-Loop-Coupled Magnetic Resonance Filters and Bandwidth Narrowing Due to Coupling Inductance." 1970 Transactions on Microwave Theory and Techniques 18.2 (Feb. 1970 [T-MTT]): 100-105.

The equivalent circuit of an orthogonal-loop-coupled magnetic resonance filter is shown to consist of a gyrator, two ferrite-induced inductances, and two coupling loop inductances. The effects of the coupling inductances on the passband and stopband responses are shown to be significant by means of calculations based on this equivalent circuit. It is proved that the maximum passband bandwidth Delta f /sub -3dB/ = f/sub 0/ (L/sub f/ / L/sub c/), where f/sub 0/, is the center frequency, and L/sub f/ and L/sub c/ the ferrite-induced and the coupling-loop inductance, respectively. Other unusual insertion-loss characteristics of this filter which differ from those of a conventional reciprocal-element bandpass filter are shown. Finally, a test circuit for determining experimentally the coupling inductance ratio L/sub c/ / L/sub f/ and the external Q, Q/sub f/ of a ferrite resonator is presented.

Abstracts

Power Flow and Energy Storage in Piezoelectric Semiconductor Devices

H. Berger, R.I. Harrison and S.P. Denker. "Power Flow and Energy Storage in Piezoelectric Semiconductor Devices." 1970 Transactions on Microwave Theory and Techniques 18.2 (Feb. 1970 [T-MTT]): 105-111.

Traditionally the phenomenological constitutive relations for piezoelectric materials explicitly relate the electric displacement D/spl ovbr/ the electric intensity E/spl ovbr/, the stress tensor, and the strain tensor. This paper presents a new formulation for the theory of coupled wave interactions in a class of important hexagonal piezoelectric devices; here an equivalent dielectric description explicitly involving only D/spl ovbr/ and E/spl ovbr/ replaces (without approximation) the traditional formulation. The new formulation supplies the foundation for a new determination of power flow and energy storage on a basis broad enough to include the effects of diffusion and collisions on multivelocity multispecies carrier streams. The results, when specialized to a single-velocity single-species carrier stream, differ significantly with others recently proposed for those circumstances. The general results display a considerable degree of compactness and simplicity and are "electrically invariant" in that they hold for insulating, photoconducting, and semiconducting piezoelectric materials without any change in basic form.

Abstracts

Further Analysis of the Off-Null Versus Power Ratio Method of Attenuation Measurement (Correspondence)

W. Larson, R.F. Desch and B.F. Gillard. "Further Analysis of the Off-Null Versus Power Ratio Method of Attenuation Measurement (Correspondence)." 1970 Transactions on Microwave Theory and Techniques 18.2 (Feb. 1970 [T-MTT]): 112-113.

Analysis of calibration data of a rotary-vane attenuator has yielded closer agreement between the recently developed off-null and the proven power ratio methods of attenuation measurement. A constant bias was discovered in the measured valures of attenuation difference, and a procedure is described to correct for this bias. After the correction is applied, the average agreement between the two methods of measurements is improved an order of magnitude, namely, from a former 2.0 percent to 0.17 percent.

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Properties of Microstrip Lines on Fused Quartz (Correspondence)

J.H.C. van Heuven, A.G. van Nie and N.V. Phillips. "Properties of Microstrip Lines on Fused Quartz (Correspondence)." 1970 Transactions on Microwave Theory and Techniques 18.2 (Feb. 1970 [T-MTT]): 113-114.

The attenuation constant for microstrip lines on fused quartz and their effective relative dielectric constant were measured and the results are discussed. The propagation losses in these lines proved to be smaller than those mentioned in the literature. The effective relative dielectric constant is found to be independent of frequency up to 12 GHz. The conductors were deposited without an adhesive layer but with sufficient adhesion for pressure bonding semiconductor chips.

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"Information on Computer Program Descriptions (Feb. 1970 [T-MTT])." 1970 Transactions on Microwave Theory and Techniques 18.2 (Feb. 1970 [T-MTT]): 115-115.

Abstracts

Capacitance Determination for Infinite Interdigital Structures (Computer Program Descriptions)

I.A. Cermak, P. Silvester and S.K. Wong. "Capacitance Determination for Infinite Interdigital Structures (Computer Program Descriptions)." 1970 Transactions on Microwave Theory and Techniques 18.2 (Feb. 1970 [T-MTT]): 116-116.

This subprogram determines the capacitance per half-strip pair of an infinitely long interdigital structure composed of finite-sized strips between dissimilar dielectrics, with or without a parallel ground plane.

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H. Berger, P.S. Carter, R.J. Clowes, S.P. Denker, R.L. Harrison, S.V. Judd, D. Kajfez, D.C. Rickard, D.H. Temme, G.N. Tsandoulas, I. Whiteley and F.G. Willwerth. "Contributors (Feb. 1970 [T-MTT])." 1970 Transactions on Microwave Theory and Techniques 18.2 (Feb. 1970 [T-MTT]): 117-118.

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"Microwave Abstracts (Feb. 1970 [T-MTT])." 1970 Transactions on Microwave Theory and Techniques 18.2 (Feb. 1970 [T-MTT]): 119-120.

Based on technical merit and timeliness, microwave papers in journals published outside the United States have been selected and compiled below, generally with brief abstracts, Reprints of the papers may be obtainable by writing directly to the author or to the source quoted.

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Simplified Analysis of Coupled Transmission-Line Networks

R. Sato and E.G. Cristal. "Simplified Analysis of Coupled Transmission-Line Networks." 1970 Transactions on Microwave Theory and Techniques 18.3 (Mar. 1970 [T-MTT]): 122-131.

A relatively simple method is presented for analyzing coupled transmission-line networks by using network graphs and graph transformations. The network graph symbolism is easy to draw and to manipulate. All the graphs consist only of inductor, capacitor, and transformer symbols, and straight lines, which represent unit elements. The method of analysis is illustrated by several two-wire-line and multiwire-line examples. Also presented are several new useful transmission-line transformations and a graph equivalent for the general coupled transmission-line network. The graph-transformation method has four principal advantages: 1) explicit open-wire-line equivalent circuits of coupled line networks can be obtained relatively easily and without knowledge of network synthesis techniques; 2) the form of equivalent circuits can often be obtained without using any algebra; 3) at each step of the analysis, a positive-real network in graph form is available; consequently, in many analysis problems several equivalent circuits for the same network are derived; and 4) multiport networks are as easily dealt with as two-port networks.

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Characteristic Impedance and Phase Velocity of a Dielectric-Supported Air Strip Transmission Line with Side Walls

D.L. Gish and O. Graham. "Characteristic Impedance and Phase Velocity of a Dielectric-Supported Air Strip Transmission Line with Side Walls." 1970 Transactions on Microwave Theory and Techniques 18.3 (Mar. 1970 [T-MTT]): 131-148.

The characteristic impedance and phase velocity of a dielectric-supported air strip transmission line with side walls and with center conductors having zero thickness have been obtained by means of the variational method. Green's functions are used for setting up the variational expression. Using a 22-term expansion for the charge distribution on the center conductors, the Rayleigh-Ritz method is then applied in the calculation of the characteristic impedance and phase velocity of the strip transmission line. Design curves are presented and a correction factor is derived that can be applied when the thickness of the center conductors is not zero. The design curves are quite general and apply equally well to any isotropic dielectric material that is used as a support, regardless of its dielectric constant. The experimental data presented verifies the theoretical results.

Abstracts

Charge and Potential Distributions in Shielded Striplines

R. Mittra and T. Itoh. "Charge and Potential Distributions in Shielded Striplines." 1970 Transactions on Microwave Theory and Techniques 18.3 (Mar. 1970 [T-MTT]): 149-156.

A new method is presented for calculating the charge and potential distribution in shielded microstrip lines with stratified dielectric fillings. The boundary value problem associated with this structure is formulated in a rigorous manner and the solution is constructed by an extension of the function-theoretic technique. Several advantages of this method are pointed out. The most important of these is its numerical efficiency. Numerical results are presented for charge and potential distributions for several choices of design parameters. The characteristic impedance and the guide wavelength are obtained from the knowledge of the charge distribution. Comparisons are made with the published data and the agreement is found to be very satisfactory.

Abstracts

Active IMPATT Diode Parameters Obtained by Computer Reduction of Experimental Data

J.W. Gewartowski and J.E. Morris. "Active IMPATT Diode Parameters Obtained by Computer Reduction of Experimental Data." 1970 Transactions on Microwave Theory and Techniques 18.3 (Mar. 1970 [T-MTT]): 157-161.

This paper describes a method of determining the junction parameters of an IMPATT device from basic microwave measurements through the use of a computer program. The technique, which evaluates the parasitic without the use of substituted impedances, and the computer program are described. Typical small and large signal results obtained on Ge and Si IMPATT devices are presented.

Abstracts

Techniques for the Measurement of Complex Microwave Conductivity and the Associated Errors

A.N. Datta and B.R. Nag. "Techniques for the Measurement of Complex Microwave Conductivity and the Associated Errors." 1970 Transactions on Microwave Theory and Techniques 18.3 (Mar. 1970 [T-MTT]): 162-166.

Complex microwave conductivity of 9 Omega /spl dot/ cm p-type silicon samples has been measured using conventional reflection and transmission bridges to examine their relative advantages and disadvantages. An attempt has been made to improve the reflection results from an analysis of the parameters of a circle diagram for reflection coefficient obtained on using a variable reactive termination after the semiconductor-filled waveguide section. In conformity with the calculated accuracy attainable from different types of measurement under the actual experimental condition, using commercial standards, the dielectric constant for the sample was found to be scattered over a region of ±0.4. It has been concluded that because of lack of accuracy in commercial standards for attenuation and phase shift, the potential accuracy of the conventional microwave methods falls too short of its mark to make any detinite conclusion about the effective mass of carriers in semiconductors at room temperatures.

Abstracts

Discussion of Some Design Methods for Dielectric Steps in Rectangular Waveguides (Correspondence)

G.P. Bava and C. Naldi. "Discussion of Some Design Methods for Dielectric Steps in Rectangular Waveguides (Correspondence)." 1970 Transactions on Microwave Theory and Techniques 18.3 (Mar. 1970 [T-MTT]): 167-168.

The problem of the junction of two rectangular waveguides partially filled with dielectric slabs is considered and a comparison with previously obtained results is carried out. A new and more approximate method is suggested and compared with the others.

Abstracts

A Gain-Stabilized Maser Radiometer for 13 cm (Correspondence)

G.D. Nicolson. "A Gain-Stabilized Maser Radiometer for 13 cm (Correspondence)." 1970 Transactions on Microwave Theory and Techniques 18.3 (Mar. 1970 [T-MTT]): 169-169.

A radiometer using noise from a neon discharge tube to effect gain stabilization of a 13-cm maser radiometer is described. A balancing technique is used to make the output insensitive to gain and bandwidth fluctuations. The output does, however, depend on the total system noise temperature, and the technique is best suited to a receiver using a low-noise traveling wave maser, whose effective noise temperature is inherently stable.

Abstracts

Design of a Class of Parallel-Coupled Quasi-Stripline Filters by Conformal Mapping (Correspondence)

I. Frigyes. "Design of a Class of Parallel-Coupled Quasi-Stripline Filters by Conformal Mapping (Correspondence)." 1970 Transactions on Microwave Theory and Techniques 18.3 (Mar. 1970 [T-MTT]): 170-171.

In some practical cases modified circular-package versions of parallel-coupled stripline filters might be more convenient than the conventional flat-package ones. This letter describes a design method for round-package interdigital, comb-line, or similar structures. The method is based on the conformal mapping of a flat filter into the desired configuration.

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An Elementary Proof of a Result Used by Otoshi (Correspondence)

T.J. Cullen. "An Elementary Proof of a Result Used by Otoshi (Correspondence)." 1970 Transactions on Microwave Theory and Techniques 18.3 (Mar. 1970 [T-MTT]): 171-171.

In a recent article, Otoshi used a matrix theoretic result at one point in his derivation. It is the purpose of this letter to present a very simple verification of that theorem, another proof of which can be found in a German textbook referenced by Abele.

Abstracts

Contributors (Mar. 1970 [T-MTT])

E.G. Cristal, A.N. Datta, J.W. Gewartowski, D.L. Gish, O. Graham, T. Itoh, R. Mittra, J.E. Morris, B.R. Nag and R. Sato. "Contributors (Mar. 1970 [T-MTT])." 1970 Transactions on Microwave Theory and Techniques 18.3 (Mar. 1970 [T-MTT]): 172-173.

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"Membership Application (Mar. 1970 [T-MTT])." 1970 Transactions on Microwave Theory and Techniques 18.3 (Mar. 1970 [T-MTT]): 175-175.

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A Study of the Single-Frequency Quenched-Domain Mode Gunn-Effect Oscillator

D.D. Khandelwal and W.R. Curtice. "A Study of the Single-Frequency Quenched-Domain Mode Gunn-Effect Oscillator." 1970 Transactions on Microwave Theory and Techniques 18.4 (Apr. 1970 [T-MTT]): 178-187.

A large-signal analysis of the high-frequency quenched-domain mode (Q-mode) of Gunn-effect devices has been developed. This is a phenomenological model and includes such effects as distinct domain formation and quenching processes, domain behavior in the presence of an RF voltage, displacement current, voltage dependence of the domain width, and others. The basis of the analysis is to obtain an instantaneous current-voltage transfer characteristic for the device and use it to generate the current waveform corresponding to a given periodic voltage waveform. The basic results of the large-signal analysis are then obtained from these current waveforms. The analysis reveals the distinguishing features of Q-mode oscillators. Admittance measurements on the oscillating device have been made and support the theoretical results for single-frequency operation. Applications of this analysis for investigating other nonlinear properties of these devices are suggested.

Abstracts

Field Distribution in a Magnetoplasma-Loaded Waveguide at Room Temperature

R. Hirota and K. Suzuki. "Field Distribution in a Magnetoplasma-Loaded Waveguide at Room Temperature." 1970 Transactions on Microwave Theory and Techniques 18.4 (Apr. 1970 [T-MTT]): 188-195.

The boundary value problem of a rectangular waveguide loaded with a thin slab of transversely magnetized semiconductor is solved with the help of a variational method. An electric field distribution showing strong nonreciprocal characteristics is obtained theoreticrdly, and is in good agreement with the experimental results performed with very thin slabs of n-InSb at room temperature.

Abstracts

Microwave Properties of Thin Films with Apertures

R.L. Ramey, H.S. Landes and E.A. Manus. "Microwave Properties of Thin Films with Apertures." 1970 Transactions on Microwave Theory and Techniques 18.4 (Apr. 1970 [T-MTT]): 196-204.

The theory of microwave transmission through thin-film screens of finite conductivity which contain circular, elliptical, and rectangular apertures and which are placed in the transverse plane of an X-band rectangular waveguide is developed. The theory is an extension of Bethe's work in which only screens with infinite conductivity were considered. Experimental verification of the theory is achieved by use of vacuum deposited thin-film screens, and the results are compared with the transmission properties of identical screens of thick foils of the same material. Significant differences are noted in the real and imaginary components of impedance presented by the thin-film and the foil screens with identical apertures. The finite conductivity of the screen is low enough to support an appreciable tangential component of electric field at the film surface.

Abstracts

Some Design Considerations and Realizations of Iris-Coupled YIG-Tuned Filters in the 12-40 GHz Region

R.L. Fjerstad. "Some Design Considerations and Realizations of Iris-Coupled YIG-Tuned Filters in the 12-40 GHz Region." 1970 Transactions on Microwave Theory and Techniques 18.4 (Apr. 1970 [T-MTT]): 205-212.

YIG filters covering the frequency ranges 12 to 18, 18 to 26, and 26 to 40 GHz have been designed and developed. The filters in the 18- to 40-GHz range were of three sections and achieved 80-MHz bandwidth and greater than 40 dB of higher order mode rejection. The filter in the 12- to 18-GHz region was of four sections utilizing staggered spheres in order to achieve a larger bandwidth filter with a minimum magnet gap. The bandwidth of this filter was 50 to 60 MHz with greater than 55 dB of higher order mode rejection. Useful information for the design of these filters was obtained with a special test fixture built to measure mutual coupling between spheres as a function of the angle between the line joining the sphere centers and the dc magnetic field. This data is reported for various iris sizes, shapes, and sphere spacings and indicates large differences in mutual coupling as the angle is varied from 0 to 90°. The effect of various types of discontinuities and iris sizes and shapes on higher order mode excitation and coupling are discussed as well as constructional problems and the design of high field magnets from vanadium permendur.

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A Latching Ring-and-Post Ferrite Waveguide Circulator

W.W. Siekanowicz, R.W. Paglione and T.E. Walsh. "A Latching Ring-and-Post Ferrite Waveguide Circulator." 1970 Transactions on Microwave Theory and Techniques 18.4 (Apr. 1970 [T-MTT]): 212-216.

This paper presents the performance and normalized design parameters for a latching ring-and-post ferrite circulator in waveguide. A C-band circulator has provided an insertion loss of 0.35 dB and a 20-dB isolation bandwidth of 17 percent. When the circulator was matched for higher maximum isolation (50 dB) but narrower bandwidth (10 percent) at room temperature, the 20-dB isolation bandwidth was 7.8 percent across the -40° to +75°C temperature range. Low-loss operation was obtained at pulsed powers up to 7.5 kilowatts, and at least 20 dB of isolation was maintained up to 100 kilowatts. This performance, in conjunction with a switching speed of a fraction of a microsecond, permits the use of these circulators for transmitting-receiving functions in high-reliability radars.

Abstracts

Characteristics of Coupled Microstrip Transmission Lines-I: Coupled-Mode Formulation of Inhomogeneous Lines

M.K. Krage and G.I. Haddad. "Characteristics of Coupled Microstrip Transmission Lines-I: Coupled-Mode Formulation of Inhomogeneous Lines." 1970 Transactions on Microwave Theory and Techniques 18.4 (Apr. 1970 [T-MTT]): 217-222.

This paper consists of two parts. In Part I, coupled-mode theory is employed to determine the effects of reflection at the various ports and unequal inductive and capacitive coupling coefficients on the coupling and directivity of two coupled lines. Since couplers utilizing microstrip lines generally have unequal inductive and capacitive coupling coefficients, the results presented here should be useful in explaining the behavior of microstrip coupled lines. It is shown how the difference in the coupling coefficients leads to finite directivity and, under certain conditions, to "codirectional" instead of "contradirectional coupling." In Part II, the coupling coefficients and other parameters of various microstrip-line geometries are presented. Using these parameters in the results obtained here leads to an improved understanding of and design criteria for coupled microstrip lines.

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Characteristics of Coupled Microstrip Transmission Lines-II: Evaluation of Coupled-Line Parameters

M.K. Krage and G.I. Haddad. "Characteristics of Coupled Microstrip Transmission Lines-II: Evaluation of Coupled-Line Parameters." 1970 Transactions on Microwave Theory and Techniques 18.4 (Apr. 1970 [T-MTT]): 222-228.

This part of the paper presents the parameters of coupled microstrip lines which are required in the equations and results derived in Part I for determining the characteristics of coupled lines. Several geometries are considered and the inductive and capacitive coupling coefficients, the effective dielectric constant, and the characteristic impedance for various dimensions of these geometries are presented.

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Measurement of Short Time Changes of Cavity Q and Resonant Frequency (Addendum)

K.R. Richter. "Measurement of Short Time Changes of Cavity Q and Resonant Frequency (Addendum)." 1970 Transactions on Microwave Theory and Techniques 18.4 (Apr. 1970 [T-MTT]): 229-229.

Formulas for the Q-factor and the resonant- frequency shift of a perturbed reflection-type cavity have been derived recently and presented in the above-mentioned paper. For the assumption that the external Q-factor, Q/sub ext/, is the same for the unperturbed and the perturbed cavity, a quadratic equation (14) for the unloaded Q-factor has been formulated. It has been pointed out that two values of Q/sub 1/ are obtained which are, respectively, smaller and greater than Q/sub 0/, the unloaded Q-factor of the unperturbed cavity. However, by inspection of (14) it may be seen that one of the roots of the quadratic equation is always equal to this Q/sub 0/.

Abstracts

A New Procedure for Calculating Varactor Q from Impedance versus Bias Measurements (Comments and Author's Reply)

N. Houlding and E.W. Sard. "A New Procedure for Calculating Varactor Q from Impedance versus Bias Measurements (Comments and Author's Reply)." 1970 Transactions on Microwave Theory and Techniques 18.4 (Apr. 1970 [T-MTT]): 229-230.

The above-mentioned paper by Sard claims rigor in the procedure. Although the author mentions the possibility of variable resistance in the varactor, he does not discuss completely the effects this might have on his analysis, and I contend that the reason why "(previously) losses in the external transformation circuitry must be either neglected or nonrigorously corrected for" is that the assumption of constant resistance is not justified. I think that the problems of circuit loss and variable resistance can not be attacked independently; and, in particular, that there is no justification for assuming the varactor will not contain loss terms which will simulate the behavior of losses in a matching network.

Abstracts

The Microwave Reflective Properties of Water Surfaces--I: The Reflectivity of Smooth Water at 19.24 and 22.43 GHz as Measured with a Free-Wave Microwave Reflectometer (Comments)

J.A. Saxton, J.A. Lane, E.J. Thompson, K.W. Gray and W.N. Hardy. "The Microwave Reflective Properties of Water Surfaces--I: The Reflectivity of Smooth Water at 19.24 and 22.43 GHz as Measured with a Free-Wave Microwave Reflectometer (Comments)." 1970 Transactions on Microwave Theory and Techniques 18.4 (Apr. 1970 [T-MTT]): 230-230.

We have read with interest the above paper which makes extensive references to our earlier work and there are a few comments we would like to make.

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Guided Waves in Limit Cases of Microstrip (Correspondence)

R.E. Eaves, Jr. and D.M. Bolle. "Guided Waves in Limit Cases of Microstrip (Correspondence)." 1970 Transactions on Microwave Theory and Techniques 18.4 (Apr. 1970 [T-MTT]): 231-232.

The great difficulty in solving for the propagation constant and effective characteristic impedance for microstrip transmission lines is invariably avoided by assuming quasi-TEM propagation and solving Laplace's equation rather than the wave equation. Deschamps and Wu have qualitatively discussed aspects of the hybrid-mode problem. Zysman and Varon have presented a solution for the related but distinctly different problem of closed microstrip. In this communication we present the basis through which the quasi-TEM analysis may be justified for the limit cases of guided waves on microstrip in which the dielectric constant approaches that of free space or becomes very large. The guided wave problem is formulated exactly in terms of longitudinal electric and magnetic field components satisfying the wave equation and coupled through the boundary conditions at the dielectric interface.

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Experimental Results on a Millimeter Wave Microstrip Down-Converter (Correspondence)

R.D. Standley and F.A. Braun. "Experimental Results on a Millimeter Wave Microstrip Down-Converter (Correspondence)." 1970 Transactions on Microwave Theory and Techniques 18.4 (Apr. 1970 [T-MTT]): 232-233.

A millimeter wave down-converter was built utilizing adhesive-backed copper tape for the microstrip circuit construction. The down-converter incorporated an IMPATT diode local oscillator and a Schottky barrier mixer diode hybrid mounted in the circuit. The performance of the unit was two dB worse than its waveguide counterpart. Optimization of the individual circuit components should permit the performance of a microstrip down-converter to approach very closely that of its waveguide counterpart.

Abstracts

Quasi-Optical Components Using Total Reflection in Dielectrics (Correspondence)

D.W. Hanson. "Quasi-Optical Components Using Total Reflection in Dielectrics (Correspondence)." 1970 Transactions on Microwave Theory and Techniques 18.4 (Apr. 1970 [T-MTT]): 233-234.

Two quasi-optical components operating at 90 GHz which use the effects of a metal plate on total reflection are described. A circular polarizer and, with the addition of a metal plate grating, a device having properties similar to a tuned turnstile junction were constricted. Experimental results showed better than 99 percent polarization conversion for the polarizer.

Abstracts

Contributors (Apr. 1970 [T-MTT])

W.R. Curtice, R.L. Fjerstad, G.I. Haddad, R. Hirota, D.D. Khandelwal, M.K. Krage, H.S. Landes, E.A. Manus, R.W. Paglione, R.L. Ramey, W.W. Siekanowicz, K. Suzuki and T.E. Walsh. "Contributors (Apr. 1970 [T-MTT])." 1970 Transactions on Microwave Theory and Techniques 18.4 (Apr. 1970 [T-MTT]): 234-235.

Abstracts

Information on Computer Program Descriptions (Apr. 1970 [T-MTT])

"Information on Computer Program Descriptions (Apr. 1970 [T-MTT])." 1970 Transactions on Microwave Theory and Techniques 18.4 (Apr. 1970 [T-MTT]): 236-236.

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Strip Line with Rectangular Outer Conductor and Three Dielectric Layers

E. Yamashita and K. Atsuki. "Strip Line with Rectangular Outer Conductor and Three Dielectric Layers." 1970 Transactions on Microwave Theory and Techniques 18.5 (May 1970 [T-MTT]): 238-244.

A general method is proposed for analyzing the transmission line characteristics of strip lines with rectangular outer conductor and multidielectric layers within a TEM wave approximation. This method uses Green's function for formulating the problem and a variational principle for obtaining practical solutions. The case of the microstrip line is first discussed, and numerical results are found to be consistent with other theories and experiments. The case of strip lines with a rectangular outer conductor and three dielectric layers is examined for various combinations of dielectric materials. Other applications of Green's function and the theoretical limitation of this method are also described.

Abstracts

Equivalent Network of a Multimode Planar Grating

I. Palocz and A.A. Oliner. "Equivalent Network of a Multimode Planar Grating." 1970 Transactions on Microwave Theory and Techniques 18.5 (May 1970 [T-MTT]): 244-252.

In this paper a plane-parallel, perfectly conducting, zero-thickness grating is analyzed by an integral equation procedure. This procedure generalizes the well-known single-mode method by taking multimode propagation into account. The grating is located in free space; viewed transversely to the plane of the structure, it is a zero-thickness shunt discontinuity in the free-space waveguide. The solution of the integral equation is obtained for E (or TM) mode excitation, when the spacing between conducting strips is small compared to a period, and it is interpreted in network terms. Finally, an explicit equivalent network is presented for the grating under multimode conditions.

Abstracts

Bandpass and Pseudo-High-Pass Quasi-Optical Filters

D.A. Leedom and G.L. Matthaei. "Bandpass and Pseudo-High-Pass Quasi-Optical Filters." 1970 Transactions on Microwave Theory and Techniques 18.5 (May 1970 [T-MTT]): 253-259.

Two forms of quasi-optical filters are discussed herein for use at millimeter-wave frequencies and possibly for far infrared frequencies. One form consists of metallic grids with intervening dielectric support material which forms a quasi-optical filter analogous to the inductively coupled waveguide bandpass filter. Because of dielectric losses, the relatively weak upper stopband, and the rapidly repeating passbands, this type of structure leaves much to be desired as a bandpass quasi-optical filter. However, when designed for wide bandwidth, it makes a very good pseudo-high-pass filter. For moderate- to wide-band bandpass applications, pseudo-high-pass filters of this type can be designed to match with a form of quasi-optical low-pass filter previously treated by the authors, in order to give a bandpass filter with strong, broad stopbands on both sides of the passband. Design principles, computed performance, and experimental results are presented for both pseudo-high-pass and bandpass structures.

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A Wide-Band Parallel-Connected Balun

H.R. Phelan. "A Wide-Band Parallel-Connected Balun." 1970 Transactions on Microwave Theory and Techniques 18.5 (May 1970 [T-MTT]): 259-263.

It is pointed out that parallel-connected baluns (4:1 impedance transformation) have approximately four times the operating bandwidth of series-connected baluns (1:1 impedance transformation). The simple theory of uncompensated resonant baluns is discussed, and design curves are presented which may be used to design any balun of this type. Experimental results are given on one type of parallel-connected balun showing it capable of a 25:1 operating bandwidth as predicted by theory. Operating over this bandwidth, the balun is only lambda/25 in length at the lower band-edge frequency. Because of its 4:1 impedance transformation, the balun should be very useful in the feeding of frequency-independent antennas with high impedance, such as the conical spiral.

Abstracts

Input Impedance Analysis of 1:1 Balun

Y. Shimada. "Input Impedance Analysis of 1:1 Balun." 1970 Transactions on Microwave Theory and Techniques 18.5 (May 1970 [T-MTT]): 264-269.

The 1:1 balun constructed of a bifilar delay line and an inverse 1:1 transformer is analyzed for its input characteristics. As a main result of the analyses, the following results were obtained about the balun in this paper. 1) Resonance occurs when the line length is equal to n (any positive integer) times half of a wavelength of the unbalanced transmission mode. 2) The lower cutoff frequency is determined by electromagnetic coupling coefficient "k/sub m/" when L/sub sigma/ and iota are constant. 3) The upper cutoff frequency is also given by a combination of k/sub m/ and k/sub e/, etc. 4) Shortening of the distance between the balun and the ground makes the resonant frequency lower when the balun has a magnetic core or when the electrostatic coupling coefficient "k/sub e/" becomes smaller and k/sub m/ is kept constant. omega/sub OI/ becomes lower. 5) In order to realize a wide-band balun, beta/sub b/ / beta/sub u/ shouId be larger and and beta/sub b/ / omega should be kept constant.

Abstracts

Input Manifolds for Microwave Channelizing Filters

W.A. Edson and J. Wakabayashi. "Input Manifolds for Microwave Channelizing Filters." 1970 Transactions on Microwave Theory and Techniques 18.5 (May 1970 [T-MTT]): 270-276.

The following sections describe two techniques for interconnecting the input ports of microwave filters suitable for sorting signals into large numbers of contiguous frequency bands. Both techniques are capable of extension to very large numbers of channels, and both are believed to be new and useful. Both have been tested at microwave frequencies and give results in reasonable agreement with those predicted. One technique uses the impedance transforming property of a uniform transmission Iine to achieve the equivalent of the directional filter. It has proved especially valuable in the design of practical filters providing large numbers of channels in several microwave frequency bands. The other is based upon a width-tapered waveguide, which serves as a space-distributed high-pass filter.

Abstracts

A Comparison of One- and Two-Idler Parametric Amplifiers (Correspondence)

A.R. Kerr. "A Comparison of One- and Two-Idler Parametric Amplifiers (Correspondence)." 1970 Transactions on Microwave Theory and Techniques 18.5 (May 1970 [T-MTT]): 277-278.

The performance of a two-idler parametric amplifer is compared with that of a single-idler amplifer with a broad-banding resonator at its input. Both circuits contain the same varactor and are pumped at the same frequency. For most of the cases considered the two-idler amplifier gives a somewhat narrower bandwidth, slightly higher noise temperature, but lower sensitivity to variation of m/sub 1/ (the pump modulation rate) than the single-idler amplifier. The comparison is made over a range of pump and varactor cutoff frequencies

Abstracts

Microwave Filters of Coupled Lines and Lumped Capacitances (Correspondence)

R. Pregla. "Microwave Filters of Coupled Lines and Lumped Capacitances (Correspondence)." 1970 Transactions on Microwave Theory and Techniques 18.5 (May 1970 [T-MTT]): 278-280.

Two frequency transformations are given which enable microwave filters to be realized with coupled lines and lumped capacitances from a characteristic prototype lumped network to a good approximation. The procedure includes filters originally proposed by Matthaei and Cristal, and enables realizations for large bandwidths. A number of examples demonstrate the efficiency of the procedures.

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Abstracts

Spectrum Analysis of Nanosecond Pulses (Correspondence)

R.G. van Welzenis and D. Daub. "Spectrum Analysis of Nanosecond Pulses (Correspondence)." 1970 Transactions on Microwave Theory and Techniques 18.5 (May 1970 [T-MTT]): 280-282.

A novel method for spectral analysis of nanosecond pulse-modulated microwave signals is presented. The technique is based on the dispersion of waveguide. It is applied to a case of microwave emission from InSb. The calibration procedure makes use of the modulating capability of the semiconductor samples themselves.

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Further Considerations on Open Resonators with Rimmed Mirrors (Correspondence)

P.F. Checcacci and A.M. Scheggi. "Further Considerations on Open Resonators with Rimmed Mirrors (Correspondence)." 1970 Transactions on Microwave Theory and Techniques 18.5 (May 1970 [T-MTT]): 282-283.

Further results are presented obtained with experimental tests on an X-band model of Fabry resonator having mirrors with step or sloped rims. A periodical trend of the power losses per transit as a function of the step rim thickness for both positive and negative values of the thickness is noted. This behavior is observed also in the mode pattern configuration. An oscillating trend of the power losses versus slope angle with smoothing maxima and minima is also observed for the sloped rim resonator. The possibility of independent field control at each side of the mirrors has also been proved.

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Abstracts

A Matched Microwave Limiter (Correspondence)

G. Chao. "A Matched Microwave Limiter (Correspondence)." 1970 Transactions on Microwave Theory and Techniques 18.5 (May 1970 [T-MTT]): 283-284.

The microwave limiter described in this correspondence is ideally reflectionless at all power levels. The matched limiter is achieved by simply adding a miniature 50-ohm rod resistor to a conventional dual-diode limiter. Although the resulting match is unilateral, it can be made bilateral by adding another diode-resistor combination. Response data of an S-band prototype unit illustrate its capabilities.

Abstracts

Mode Charts for Cylindrical Microwave Resonators (Computer Program Descriptions)

A.M. Muc, I.R. Dagg and G.E. Reesor. "Mode Charts for Cylindrical Microwave Resonators (Computer Program Descriptions)." 1970 Transactions on Microwave Theory and Techniques 18.5 (May 1970 [T-MTT]): 285-285.

This program calculates, prints, and plots the data for mode charts. Frequency range, cavity parameters, graph size, grid spacing, and required modes are all user specified.

Abstracts

Contributors (May 1970 [T-MTT])

K. Atsuki, W.A. Edson, D.A. Leedom, G.L. Matthaei, A.A. Oliner, I. Palocz, H.R. Phelan, Y. Shimada, J. Wakabayashi and E. Yamashita. "Contributors (May 1970 [T-MTT])." 1970 Transactions on Microwave Theory and Techniques 18.5 (May 1970 [T-MTT]): 286-287.

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Information on Computer Program Descriptions (May 1970 [T-MTT])

"Information on Computer Program Descriptions (May 1970 [T-MTT])." 1970 Transactions on Microwave Theory and Techniques 18.5 (May 1970 [T-MTT]): 288-288.

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Abstracts

A Low-Pass Prototype Network for Microwave Linear Phase Filters

J.D. Rhodes. "A Low-Pass Prototype Network for Microwave Linear Phase Filters." 1970 Transactions on Microwave Theory and Techniques 18.6 (Jun. 1970 [T-MTT]): 290-301.

A new approximation theory is presented for a low-pass prototype filter which simultaneously optimizes both the passband amplitude and phase response of the scattering transfer coefficient over the same finite band. This closed form solution is expressed in terms of single polynomial, which is readily generated through a simple recurrence formula, and has been termed the equidistant linear phase polynomial since its phase deviation from linearity vanishes at equidistant points along the real frequency axis. A synthesis procedure is presented for the realization of this transfer function using a resistively terminated, symmetrical, lossless, two-port network where extensive use is made of the immittance inverter concept. The even-mode admittance, which defines the network, possesses a simple closed form representation in terms of the equidistant linear phase polynomial and its derivative, and consequently, the entire theory is derived in an analytic form. Typical performance characteristics are graphically presented for networks of up to 14th degree, illustrating the superiority of this new approach over any other known form of approximation theory for selective linear phase filters.

Abstracts

The Generalized Interdigital Linear Phase Filter

J.D. Rhodes. "The Generalized Interdigital Linear Phase Filter." 1970 Transactions on Microwave Theory and Techniques 18.6 (Jun. 1970 [T-MTT]): 301-307.

The design theory is presented for narrow-band generalized interdigital linear phase filters which consist of a pair of identical cross-coupled interdigital lines. The procedure for the determination of the characteristic admittances of the elements which describe the structure based upon the element values of the low-pass linear phase prototype network is given, from which the physical dimensions of the filter may readily be obtained. The measured performance characteristics of two filters are presented. The first is a 2.5 percent bandwidth 14-element filter based upon the maximally flat prototype operating in L-band, and the second is a 1 percent bandwidth 18-element version based upon the finite band prototype in S-band. Both filters are shown to be in excellent agreement with theory, with the latter exhibiting transfer characteristics considerably superior to those obtainable from any form of conventionally equalized filter of similar overall degree.

Abstracts

The Generalized Direct-Coupled Cavity Linear Phase Filter

J.D. Rhodes. "The Generalized Direct-Coupled Cavity Linear Phase Filter." 1970 Transactions on Microwave Theory and Techniques 18.6 (Jun. 1970 [T-MTT]): 308-313.

A procedure is described whereby narrow-band waveguide generalized direct-coupled cavity linear phase filters may be designed from a low-pass prototype linear phase network. The structure is comprised of two identical conventional half-wave direct-coupled cavity filters with shunt inductive irises, cross coupled by small apertures in the narrow wall between adjacent cavities. Explicit formulas for the susceptances of the irises, the cross coupling apertures, and the electrical lengths of the cavities are given in terms of the element values of the low-pass prototype. Measured results on two X-band filters are given with fractional bandwidths of 0.15 percent and 0.85 percent. Both were designed upon the maximally flat prototype, the former being an 8-cavity filter while the latter is a 14-cavity version and illustrates the dispersion effect due to the frequency-dependence of the inductive irises.

Abstracts

Diffraction Efficiencies for Infinite Perfectly Conducting Gratings of Arbitrary Profile

R.B. Green. "Diffraction Efficiencies for Infinite Perfectly Conducting Gratings of Arbitrary Profile." 1970 Transactions on Microwave Theory and Techniques 18.6 (Jun. 1970 [T-MTT]): 313-318.

Integral equations are obtained for the currents induced on an infinite perfectly conducting grating by a plane wave. The integral equations are approximated by matrix equations which are readily solved for the currents. Once the currents are known one can obtain the strengths of the grating modes. Numerical results are obtained for specific cases which have been considered previously in some optical experiments by Madden and Strong. The theoretical results are consistent with the conservation of energy. However, there are discrepancies with the experimental results. An equivalent problem of reflections in a terminated waveguide is also considered and good agreement between theory and experiment is obtained. The technique is extendible to dielectric gratings.

Abstracts

Coplanar-Waveguide Directional Couplers

C.P. Wen. "Coplanar-Waveguide Directional Couplers." 1970 Transactions on Microwave Theory and Techniques 18.6 (Jun. 1970 [T-MTT]): 318-322.

Design information for coplanar-waveguide directional couplers has been calculated using quasi-static zeroth-order approximations. Experimental results on a 10-dB directional coupler designed from these calculations have shown reasonably good agreement with predictions. The smaller difference in even- and odd-mode velocity in a coplanar-waveguide directional coupler leads to better directivity and better performance than a microstrip directional coupler.

Abstracts

Isolation Rating of Ferrite Components at High Pulse Powers (Correspondence)

K.G. Narayanan and G.P. Sharma. "Isolation Rating of Ferrite Components at High Pulse Powers (Correspondence)." 1970 Transactions on Microwave Theory and Techniques 18.6 (Jun. 1970 [T-MTT]): 322-323.

Any method used to measure the isolation provided by a ferrite component at high pulse powers must also consider the effect of possible distortion to the pulse shape owing to the nonlinear phenomena in ferrites. When such pulse shape distortion occurs, measurement methods based on average crystal current measurement or temperature rise in a calorimeter yield erroneous results. It is necessary that the method of measurement of isolation must be one which finds the difference between the maximum heights of the input and output pulses to the component irrespective of the pulse shape at the two ports.

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Abstracts

Effects of Video Detector Saturation on Radiometer Linearity (Correspondence)

J.R. Cogdell and W.-H. Su. "Effects of Video Detector Saturation on Radiometer Linearity (Correspondence)." 1970 Transactions on Microwave Theory and Techniques 18.6 (Jun. 1970 [T-MTT]): 324-325.

The effects of video detector saturation on the overall linearity of a radiometric receiver are analyzed. A simple model of the detector is used and the stochastic nature of the signals is allowed for. A useful design formula is derived.

Abstracts

On the Legitimacy of an Assumption Underlying the Point-Matching Method (Correspondence)

R.F. Millar and R.H.T. Bates. "On the Legitimacy of an Assumption Underlying the Point-Matching Method (Correspondence)." 1970 Transactions on Microwave Theory and Techniques 18.6 (Jun. 1970 [T-MTT]): 325-327.

The numerical solution of boundary value problems for the Helmholtz equation by the point-matching method presupposes the legitimacy of a specific representation of the solution. A necessary and sufficient condition is given for its validity. Earlier arguments purporting to show that the representation is valid only for circular cylinders, or for cylinders possessing certain symmetries, are shown to be unsound.

Abstracts

Effect of Harmonic and Subharmonic Signals on Avalanche-Diode Oscillator Performance (Correspondence)

W.E. Schroeder and G.I. Haddad. "Effect of Harmonic and Subharmonic Signals on Avalanche-Diode Oscillator Performance (Correspondence)." 1970 Transactions on Microwave Theory and Techniques 18.6 (Jun. 1970 [T-MTT]): 327-331.

The purpose of this correspondence is to show the effects of harmonic and subharmonic signals on the operation of an avalanche-diode oscillator. Generation of harmonic and subharmonic signals is also considered.

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R.B. Green, J.D. Rhodes and C.P. Wen. "Contributors (Jun. 1970 [T-MTT])." 1970 Transactions on Microwave Theory and Techniques 18.6 (Jun. 1970 [T-MTT]): 331-331.

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Abstracts

A Theoretical Analysis of Discrete Reflecting Beam Waveguide with Parabolic Cylindrical Reflectors

M. Suzuki, M. Kamimura and S. Fujiki. "A Theoretical Analysis of Discrete Reflecting Beam Waveguide with Parabolic Cylindrical Reflectors." 1970 Transactions on Microwave Theory and Techniques 18.7 (Jul. 1970 [T-MTT]): 338-347.

A discrete reflecting beam waveguide with parabolic cylindrical reflectors, proposed by M. Kamimura, is theoretically analyzed. Electric field elementary waves on the reflector and the exciting primary electric field from the launcher are represented in the elliptic cylindrical coordinate system, and boundary conditions on the reflector are introduced to derive simultaneous integral equations regarding the reflector current. By solving these integral equations approximately, the integral representation of the secondary electric field in the beam waveguide is obtained, and poles and residues of the integrand are calculated to obtain the propagation constant of the beam waveguide and beam waveguide modes. The beam waveguide mode reflected toward the transmitting side when an obstacle is placed in the beam waveguide is obtained.

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Experiments of a Discrete Reflecting Beam Waveguide with Parabolic Cylindrical Reflectors

M. Kamimura, M. Watanabe, K. Mikoshiba and M. Suzuki. "Experiments of a Discrete Reflecting Beam Waveguide with Parabolic Cylindrical Reflectors." 1970 Transactions on Microwave Theory and Techniques 18.7 (Jul. 1970 [T-MTT]): 348-351.

The new beam waveguide with parabolic cylindrical reflectors, analyzed in another paper, has been constructed and experimentally investigated. The measurement of the attenuation is in fairly good agreement with the theoretical attenuation constant if surface roughness and installation error of the reflector are taken into account. By the fundamental experiment for train radar application, with various obstacles placed inside this beam waveguide, it is shown that the measured reflection from metallic obstacles is in good agreement with theoretical calculations.

Abstracts

Considerations on Matrix Methods and Estimation of Their Errors

M. Hashimoto and K. Fujisawa. "Considerations on Matrix Methods and Estimation of Their Errors." 1970 Transactions on Microwave Theory and Techniques 18.7 (Jul. 1970 [T-MTT]): 352-359.

Two-dimensional field equations are reduced to Fredholm integral equations of the second kind. The integral equations are solved by matrix methods. The convergence of the matrix solutions is discussed. The matrix methods are applied to calculating the cutoff wavenumbers of waveguides. A method of estimating the errors is proposed. A method of correcting the matrix solutions is described and applied to a field problem in which the boundary is large compared with the wavelength. It is pointed out that for the commonest method of solving integral equations numerically (the method of subsections), the accuracy depends strongly on the position in each subsection of the point to which the field is referred. The dependence of the error on position is examined quantitatively.

Abstracts

Millimeter Wave Attenuation through Illuminated Semiconductor Panel

R. Mavaddat. "Millimeter Wave Attenuation through Illuminated Semiconductor Panel." 1970 Transactions on Microwave Theory and Techniques 18.7 (Jul. 1970 [T-MTT]): 360-364.

Attenuation of millimeter wave energy through light-illuminated semiconductor panels is determined. The expressions for the attenuation are applied to cases of uniform circular light excitation and laser beam excitation of the panel. Families of curves are given for the attenuation as a function of ratio of distance from the center of excitation to the diffusion length of the semiconductor material. The effect of surface recombination velocities of semiconductor panels is also considered.

Abstracts

On the Inadequacy of Discrete Mode-Matching Techniques in Some Waveguide Discontinuity Problems

L. Lewin. "On the Inadequacy of Discrete Mode-Matching Techniques in Some Waveguide Discontinuity Problems." 1970 Transactions on Microwave Theory and Techniques 18.7 (Jul. 1970 [T-MTT]): 364-369.

It is shown that inattention to the limits of validity of a field expansion can lead to field matching along impermissible boundaries. Nevertheless the error may not show up in any obvious way, since the method amounts to an expansion in terms of an incomplete modal set. The "diffusion" of a discrete mode into a continuum takes place in a distance which may be of the order of a tenth of a wavelength or more, so that in fact fairly accurate numerical results can nevertheless ensue over quite a range of parameters. This would seem to be the case for some examples taken from the literature in which the analysis has apparently been undertaken on the assumption that the initial formulation was exact.

Abstracts

On the Inadequacy of Discrete Mode-Matching Techniques in Some Waveguide Discontinuity Problems (Discussion)

E.D. Nielsen and L. Lewin. "On the Inadequacy of Discrete Mode-Matching Techniques in Some Waveguide Discontinuity Problems (Discussion)." 1970 Transactions on Microwave Theory and Techniques 18.7 (Jul. 1970 [T-MTT]): 369-372.

Lewin presents a criticism of some previous papers on point-matching techniques, stating that the field representation applied in these papers is defective or incomplete in part of the region where it has been applied. This assertion, however, is not relevant for the example given in Section IV, where a previous work of mine is discussed. This is shown by the following argumentation.

Abstracts

Transmission Bandwidth of a Lens Waveguide with a Curved Axis

J. Hirano and H. Yoshikiyo. "Transmission Bandwidth of a Lens Waveguide with a Curved Axis." 1970 Transactions on Microwave Theory and Techniques 18.7 (Jul. 1970 [T-MTT]): 373-376.

In a lens waveguide with a curved axis, light beams appreciably different in frequency split and take different paths due to the effect of chromatic aberration of lens. The deviation from a main beam can grow cumulatively through the curved lens waveguide. This effect knits permissible bandwidth to be transmitted without loss of beams. For bends having tilts and offsets at the connections to the straight waveguides, the deviation of the light beam from the guide axis due to the effect of chromatic aberration is derived. With random circular bends the bandwidth is inversely proportional to the square root of the number of bends and proportional to the average radius of curvature. For a normal design of the curved waveguide the allowable bandwidth is expected to be sufficiently broad for signal transmission, but it is narrow in the sense of optical frequency.

Abstracts

Microwave Properties of Slabs of Uniformly Magnetized Material Filling the Cross Section of a Rectangular Waveguide Operating in TE/sub NO/ Modes

K.C. O'Brien. "Microwave Properties of Slabs of Uniformly Magnetized Material Filling the Cross Section of a Rectangular Waveguide Operating in TE/sub NO/ Modes." 1970 Transactions on Microwave Theory and Techniques 18.7 (Jul. 1970 [T-MTT]): 377-382.

The microwave properties of a slab of uniformly magnetized material filling the cross section of an infinite, lossless rectangular waveguide operating only in TE/sub NO/ modes are discussed analytically. The material is assumed to have a scalar permittivity and a permeability describable by a tensor of the Polder form. A dc magnetic field is applied normal to the broad wall of the waveguide. Two cases are treated in detail. 1) The slab is placed against a metal shorting wall. 2) The slab is placed with empty waveguide on each side. A general analytical solution is obtained for both cases. Numerical values are computed for MnF/sub 2/, an easy-axis antiferromagnet. The computed values for the second are compared with values calculated on the basis of a plane-wave approximation and with experimental data. Applications of the technique to experimental measurements are described.

Abstracts

Coupling of Modes on a Tapered Dielectric Cylinder

A.W. Snyder. "Coupling of Modes on a Tapered Dielectric Cylinder." 1970 Transactions on Microwave Theory and Techniques 18.7 (Jul. 1970 [T-MTT]): 383-392.

A generalized coupled-mode formulation is presented for propagation in nonuniform media, where the modes are those associated with both the discrete and continuous eigenvalue spectrum. The theory includes metallic and dielectric waveguide non-uniformities as special limiting cases. Analytic results are presented for a multimode linear tapered dielectric cylinder excited by the HE/sub 11/ mode.

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The Influence of Cataphoresis Upon the Noise Temperature of F8T5 Lamps

R.E. Guentzler. "The Influence of Cataphoresis Upon the Noise Temperature of F8T5 Lamps." 1970 Transactions on Microwave Theory and Techniques 18.7 (Jul. 1970 [T-MTT]): 393-400.

Fluorescent lamps were once used as standard noise sources for microwave measurements. Because of unpredictable noise output, they were abandoned in favor of pure-gas discharge tubes. It is shown that the unpredictability resulted from changes in Hg vapor pressure which were indirectly caused by cataphoretic pumping of the Hg ions. Data are presented which give excess noise as a function of discharge current and as a function of bulb temperature. These data were obtained for normal and abnormal lamps at 147 MHz.

Abstracts

Microwave Properties of a Rectangular Waveguide Semi-Infinitely Filled with Magnetic Material (Correspondence)

K.C. O'Brien. "Microwave Properties of a Rectangular Waveguide Semi-Infinitely Filled with Magnetic Material (Correspondence)." 1970 Transactions on Microwave Theory and Techniques 18.7 (Jul. 1970 [T-MTT]): 400-402.

An infinite, lossless, rectangular waveguide semi-infinitely filled with a transversely magnetized magnetic material is discussed. With the limitation that only TE/sub no/ modes are incident, an analytic solution for the transmitted and reflected energies is presented. Numerical computations near resonance are presented both for a ferrite and an easy-axis antiferromagnet.

Abstracts

Design Tables for a Class of Optimum Microwave Bandstop Filters (Correspondence)

O.P. Gupta and R.J. Wenzel. "Design Tables for a Class of Optimum Microwave Bandstop Filters (Correspondence)." 1970 Transactions on Microwave Theory and Techniques 18.7 (Jul. 1970 [T-MTT]): 402-404.

Element value tables for optimum microwave bandstop filters consisting of quarter-wave spaced shunt open-circuited stubs are given. Both the stubs and the connecting unit elements contribute to the attenuation response. The tables give element values for 0.01dB, 0.10 dB, and 0.25 dB ripple Chebyshev designs with up to twenty-three elements, and for bandwidths between 30 percent and 150 percent.

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Propagation in a Rectangular Waveguide Partially Filled with a Linearly Varying Dielectric (Correspondence)

G. Gonzalez and V.R. Johnson. "Propagation in a Rectangular Waveguide Partially Filled with a Linearly Varying Dielectric (Correspondence)." 1970 Transactions on Microwave Theory and Techniques 18.7 (Jul. 1970 [T-MTT]): 404-406.

A closed form solution for the TE/sub lo/ mode in a rectangular waveguide partially filled with a linearly inhomogeneous dielectric is obtained. The dielectric is assumed to vary linearly in one transverse direction. The theory developed for the partially filled waveguide is extended to consider the characteristic equation of the completely filled waveguide with a linearly inhomogeneous dielectric. The phase velocity of the fields in the waveguide is studied by considering the omega / beta diagrams.

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Comparisons of Waveguide Losses Calibrated by the DC Potentiometer, AC Ratio Transformer, and Reflectometer Techniques (Correspondence)

T.Y. Otoshi, C.T. Stelzried, B.C. Yates and R.W. Beatty. "Comparisons of Waveguide Losses Calibrated by the DC Potentiometer, AC Ratio Transformer, and Reflectometer Techniques (Correspondence)." 1970 Transactions on Microwave Theory and Techniques 18.7 (Jul. 1970 [T-MTT]): 406-409.

Comparisons are made of the losses of two precision waveguide sections that were calibrated by three independent attenuation measurement methods. The loss measurement systems involved were the 1) dual-channel system which uses thermistors and a dc potentiometer test set, 2) dual-channel system which uses barretters and an ac ratio transformer test set, and 3) National Bureau of Standards reflectometer system which utilizes a quarter-wave short circuit and an IF attenuation standard. Loss values of about 0.05 dB, as calibrated by the three independent methods, typically agreed to within 0.0006 dB. It is believed that the results of these calibrations are representative of the best that can be achieved with current state-of-the-art techniques and available instrumentation for low-loss waveguide measurements.

Abstracts

An 18 GHz Single-Tuned Parametric Amplifier with Large Gain Bandwidth Product (Correspondence)

Y. Kinoshita and M. Maeda. "An 18 GHz Single-Tuned Parametric Amplifier with Large Gain Bandwidth Product (Correspondence)." 1970 Transactions on Microwave Theory and Techniques 18.7 (Jul. 1970 [T-MTT]): 409-410.

A single-tuned parametric amplifier was experimentally demonstrated at 18 GHz. A coaxial signal circuit and a radial idler cavity were used to obtain a large voltage-gain bandwidth product of 1440 MHz and a low noise temperature of 245°K including the circulator loss contribution.

Abstracts

A Simple Technique for Real-Time Measurement of Complex Reflection Coefficient (Correspondence)

G.H. Glover. "A Simple Technique for Real-Time Measurement of Complex Reflection Coefficient (Correspondence)." 1970 Transactions on Microwave Theory and Techniques 18.7 (Jul. 1970 [T-MTT]): 410-412.

A simple method for making real-time measurements of complex reflection coefficient p/sub x/ is described. The technique uses a hybrid tee and two crystal detectors to provide analog outputs from which the reflection coefficient is obtained. Sample measurements of p/sub x/ made at 34.3 GHz are presented which indicate a precision of greater than 0.02 units and 0.05 radians in magnitude and argument, respectively, for 0.1<= |p/sub x/| <= 1.0.

Abstracts

A Computer Optimization of the Rayleigh-Ritz Method (Correction)

A. Vander Vorst. "A Computer Optimization of the Rayleigh-Ritz Method (Correction)." 1970 Transactions on Microwave Theory and Techniques 18.7 (Jul. 1970 [T-MTT]): 412-412.

Equations (1) through (5) are valid for LSM modes, and not for LSE modes as stated in Section II.

Abstracts

Contributors (Jul. 1970 [T-MTT])

S. Fujiki, K. Fujisawa, R.E. Guentzler, M. Hashimoto, J. Hirano, M. Kamimura, L. Lewin, R. Mavaddat, K. Mikoshiba, K.C. O'Brien, A.W. Snyder, M. Suzuki, M. Watanabe and H. Yoshikiyo. "Contributors (Jul. 1970 [T-MTT])." 1970 Transactions on Microwave Theory and Techniques 18.7 (Jul. 1970 [T-MTT]): 412-414.

Abstracts

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Abstracts

Calculation of Radiation Fields in Waveguides by a Principle of Power Balance

I. Kaufman. "Calculation of Radiation Fields in Waveguides by a Principle of Power Balance." 1970 Transactions on Microwave Theory and Techniques 18.8 (Aug. 1970 [T-MTT]): 418-425.

A simple formula is derived for calculating the amplitude of the field that is due to an elemental radiator which radiates into a particular waveguide mode. The method used is based on rather elementary principles, and appeals readily to physical intuition. In this technique, the field radiated into an infinite-length waveguide is obtained from the expression for the field developed by the radiator in a traveling wave resonator formed of this waveguide, where this expression is found by use of the Poynting theorem. While derived for the electromagnetic system, the method and formula can be applied to other waveguide systems, such as mechanical, mixed, or others. Several examples are given to illustrate the use of the method.

Abstracts

A Microwave Correlator Employing YIG Delay Lines

S.F. Payer, R.A. Moore and P.H. Pincoffs. "A Microwave Correlator Employing YIG Delay Lines." 1970 Transactions on Microwave Theory and Techniques 18.8 (Aug. 1970 [T-MTT]): 426-432.

A device is described which performs the operation of correlation at microwave frequencies (L-band). Signal delay is provided by two transmission mode yttrium-iron-garnet delay lines magnetically biased for magnetoelastic wave propagation. Variation of delay is effected by electronically changing the magnetic bias on each delay line. Because group and phase delay are different functions of applied magnetic field, the autocorrelation function obtained for band-limited signals exhibits a sidelobe structure dependent on group delay variation and a fine structure which depends on phase delay variation. Calculations and experimental results are given for a sinusoidally frequency-modulated signal of large modulation index. This signal has a power spectrum with sharply defined frequency limits, easily variable bandwidth, and provides an autocorrelation function with a zero-order Bessel function amplitude variation.

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Propagation on a Cylindrical Surface Wave Structure Having Radially Nonuniform Dielectric

R.L. Gallawa. "Propagation on a Cylindrical Surface Wave Structure Having Radially Nonuniform Dielectric." 1970 Transactions on Microwave Theory and Techniques 18.8 (Aug. 1970 [T-MTT]): 432-436.

The possibility that a radially nonuniform dielectric might enhance the propagation characteristics of a surface wave line is discussed in terms of the axial cylindrical surface wave on a cylindrical structure. Attention is given to the field structure in the dielectric to determine the effect of the nonuniformity on the dielectric loss. Conclusions are deferred, however, until the change in surface impedance is also examined, since it essentially determines conductor loss and decay coefficient. The surface impedance is examined using the radial transmission line formalism of Marcuvitz. The modified field structure in the nonuniform dielectric and the concomitant change in dielectric loss is found to be most important for the surface wave structure; the nonuniformity changes the surface impedance only slightly since it is already highly reactive.

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Numerical Solution of Waveguide Scattering Problems by Finite-Difference Green's Functions

J.I. Glaser. "Numerical Solution of Waveguide Scattering Problems by Finite-Difference Green's Functions." 1970 Transactions on Microwave Theory and Techniques 18.8 (Aug. 1970 [T-MTT]): 436-443.

A finite-difference Green's function method for solving time-harmonic wave guide scattering problems involving metallic obstacles of finite size by computer is described. The method is applied to the two-dimensional problem of a TE/sub 10/ mode impinging on cylindrical metallic posts of arbitrary shape in a rectangular waveguide. The equivalent susceptance of a transverse semidiaphragm computed using a 50 point approximation for the induced current distribution is found to be 1.5 percent less than the exact value. The S matrix of a thin bent window versus wavelength is also presented.

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On the Theory of Low-Frequency Excitation of Cavity Resonators

H.A. Mendez. "On the Theory of Low-Frequency Excitation of Cavity Resonators." 1970 Transactions on Microwave Theory and Techniques 18.8 (Aug. 1970 [T-MTT]): 444-448.

The theory of modal expansions in an ideal cavity, in the presence of low-frequency current and charge distributions, is developed using the scalar and dyadic Green's functions. The case of a vertical antenna in a rectangular cavity is solved in detail, and the need for irrotational as well as solenoidal eigenvectors in the solution is established. The solutions are obtained in double-sum form, achieving an important computational advantage. Finally, the theory is checked against experimentally measured field distributions, obtaining excellent agreement and shedding light onto the unique behavior of the fields inside a cavity at frequencies below the first resonance.

Abstracts

Coaxial-Slot Surface Wave Launchers

W.J. Dewar and J.C. Beal. "Coaxial-Slot Surface Wave Launchers." 1970 Transactions on Microwave Theory and Techniques 18.8 (Aug. 1970 [T-MTT]): 449-455.

The radiation characteristics of 360° circumferential slots in rigid dielectric-coated coaxial cable are studied both theoretically and experimentally. The ultimate aim of this work is to use an array of such slots to launch a surface wave on the Goubau line formed by the outer conductor of the coaxial cable and the concentric dielectric coating. The possible advantage of this method over that of the flared horn is that the launching efficiency is controlled by the length of the launchlng section and is relatively independent its cross-sectional area.

Abstracts

Sommerfeld Pre- and Postcursors in the Context of Waveguide Transients

E.O. Schulz-DuBois. "Sommerfeld Pre- and Postcursors in the Context of Waveguide Transients." 1970 Transactions on Microwave Theory and Techniques 18.8 (Aug. 1970 [T-MTT]): 455-460.

For propagation in lossless waveguide, the rigorous impulse response function is given. It is shown that its instantaneous frequency is that which has reached the output at that time by propagating at the group velocity. For a square envelope pulse with a carrier frequency omega above the cutoff frequency omega/sub c/, the propagation of the envelope and of the phase are essentially described by the group and phase velocity, respectively. In addition, however, the bulk of the pulse is preceded by the so-called Sommerfeld precursors having an increasing amplitude and a frequency which decreases from a high value to omega. Similarly the bulk of the pulse k followed by the Sommerfeld postcursors in which both amplitude and frequency decrease, the latter from omega to omega/sub c/. The analytic results are illustrated by computed examples of waveguide transients.

Abstracts

Anisotropic Slabs in Rectangular Waveguides

F.E. Gardiol. "Anisotropic Slabs in Rectangular Waveguides." 1970 Transactions on Microwave Theory and Techniques 18.8 (Aug. 1970 [T-MTT]): 461-467.

The problem of electromagnetic wave propagation in a rectangular waveguide containing anisotropic slabs was considered by several authors. Their treatments, however, only cover particular cases (lossless media, TE/sub m0/ modes); they do not provide all the information required for the design of microwave devices such as ferrite isolators, which are still developed by empirical methods. The treatment presented here brings closer together the basic theory and the actual design work. A rectangular waveguide having any number of linear anisotropic and isotropic lossy slabs extending across it, is considered. It is shown that an exact solution for the fields of all the modes can be obtained when the material properties meet certain requirements. A matrix formalism is used to derive the dispersion relations, which are then solved with the help of a computer program. Experimental results show good agreement with the computed values.

Application of a Variation-Iteration Method to Inhomogeneously Loaded Waveguides

A.S. Vander Vorst and R.J.M. Govaerts. "Application of a Variation-Iteration Method to Inhomogeneously Loaded Waveguides." 1970 Transactions on Microwave Theory and Techniques 18.8 (Aug. 1970 [T-MTT]): 468-475.

An approximate technique for eigenvalue equations, the variation-iteration method, is commonly used in theoretical physics. Through an adequate numerical treatment it reduces to the inverse iteration method. It is shown here that this technique is most promising. Starting from an initial trial function, iterates are calculated, in which the components relative to the unwanted true eigenfunctions are eliminated. Both an upper and a lower bound of the unknown eigenvalues are calculated. This leads to an approbate eigenvalue within a specified accuracy with respect to the exact (unknown) eigenvalue. An extrapolation technique further accelerates the convergence. The computation time is shorter than when using the Rayleigh-Ritz procedure. The method is applied here to the dielectric-slab loaded waveguide, because the exact solution is available to check the validity of the method. The influence of the geometry, the dielectric constant, and the frequency is evaluated.

Abstracts

Analysis and Evaluation of a Method of Measuring the Complex Permittivity and Permeability of Microwave Insulators

W.E. Courtney. "Analysis and Evaluation of a Method of Measuring the Complex Permittivity and Permeability of Microwave Insulators." 1970 Transactions on Microwave Theory and Techniques 18.8 (Aug. 1970 [T-MTT]): 476-485.

Theory and experimental results are presented to show the possibility of using a resonant post technique for characterizing dielectric and magnetic materials at microwave frequencies. Results of the temperature dependence of the relative dielectric constant of nonmagnetic materials with epsilon/sub r/, varying from 4 to 60 are presented and also loss tangent measurements at room temperature. The complex permittivity and permeability of a number of garnet materials has also been measured with 4pi gamma M/sub s/ /omega varying from 0.25 to 0.8. The measured real part of the permeability is in good agreement with the theoretical predictions of Schlomann and the imaginary part of the permeability agrees with measurements by Green et al. on similar materials.

Abstracts

Guided-Wave Theory of Light Diffraction by Acoustic Microwaves (Reprint) (Aug. 1970 [T-MTT])

R.-S. Chu and T. Tamir. "Guided-Wave Theory of Light Diffraction by Acoustic Microwaves (Reprint) (Aug. 1970 [T-MTT])." 1970 Transactions on Microwave Theory and Techniques 18.8 (Aug. 1970 [T-MTT]): 486-504.

Reprinted from IEEE Transactions on Microwave Theory and Techniques, Volume MTT-17, Number 11, November 1969, pp. 1002-1020, to correct printing inconsistencies. The distraction of a plane light wave incident obliquely upon an isotropic dielectric layer traversed Iongitudinally by an acoustic microwave is examined by means of a guided-wave approach. In addition to a considerable amount of physical insight, this approach provides a wide range of techniques that have already been developed extensively in the area of electromagnetic microwaves. As a consequence, available methods can be used to explain and express known aspects of the diffracted light in terms of simple guided-wave concepts which are applied herein to derive results that have not been available. It is shown that the diffracted field within the dielectric layer, as well as in the exterior (air) medium, can be described by means of two alternative modal representations: 1) a description in terms of characteristic modes which progress independentiy of each other, and 2) a description in terms of coupled modes which interact with each other in the presence of the acoustic wave. While the two representations are equivalent, each has its own advantages and both are discussed in detail. It is also shown that these representations lead to equivalent networks that maybe utilized to account for boundary conditions and for other features of the scattered field. In particular, diffraction phenomena in a Bragg regime are carefuly investigated; qualitative and quantitative results are presented for situations wherein the orientation of the optic-acoustic interaction occurs at a Bragg angle of arbitrary order.

Abstracts

An Experimental Comparison Between Direct and Indirect PAM by a High-Efficiency Microwave Frequency Multiplier with Varactor Diodes (Correspondence)

A.M. Markovic. "An Experimental Comparison Between Direct and Indirect PAM by a High-Efficiency Microwave Frequency Multiplier with Varactor Diodes (Correspondence)." 1970 Transactions on Microwave Theory and Techniques 18.8 (Aug. 1970 [T-MTT]): 504-506.

Two pulse amplitude modulation (PAM) methods by a high-efficiency frequency multiplier with varactor diodes are compared. Typical results achieved for an X-band to Q-band tripler prove that the direct PAM is better than the indirect one under the same conditions. The former acts as a pulse shaper (PS), and has an output rise time smaller than the rise time of the output voltage of the modulator chain.

Abstracts

Criterion for Nonreciprocal Injection Locking of Bilateral Microwave Oscillators (Correspondence)

B.S. Perlman and T.E. Walsh. "Criterion for Nonreciprocal Injection Locking of Bilateral Microwave Oscillators (Correspondence)." 1970 Transactions on Microwave Theory and Techniques 18.8 (Aug. 1970 [T-MTT]): 507-508.

A criterion is presented for establishing the required degree of isolation between injection-locked microwave oscillators to prevent reverse locking. In particular, the effect of circulator directivity and oscillator harmonics on the performance of the locking circuit is discussed. The injection-locked performance of pulsed and CW transferred electron oscillators is used as an example.

Abstracts

Crossed-Cylinder Microwave Resonator (Correspondence)

B.M. Schiffman. "Crossed-Cylinder Microwave Resonator (Correspondence)." 1970 Transactions on Microwave Theory and Techniques 18.8 (Aug. 1970 [T-MTT]): 509-510.

An open-type X-band resonator was constructed of two cylindrical reflectors with crossed axes, separated by half the radius of curvature. The diffraction loss of this structure was found to be several orders of magnitude less than when the axes of the cylinders were made parallel, while the otherwise equivalent flat-flat resonator had the highest loss of all. A formula for the resonant frequencies of spherical confocal resonators, suitably modified, was found to predict the lowest mode resonances of the crossed-cylinder resonator with good accnracy.

Abstracts

Spinwave Linewidth Measurements with Low-Power RF Sources (Correspondence)

W.E. Courtney and D.H. Temme. "Spinwave Linewidth Measurements with Low-Power RF Sources (Correspondence)." 1970 Transactions on Microwave Theory and Techniques 18.8 (Aug. 1970 [T-MTT]): 510-510.

This correspondence describes a perturbation technique for obtaining the spinwave linewidth of polycrystalline garnet spheres with large values of Delta H/sub k/. Conventions waveguide cavity techniques require power levels in the kilowatt region to excite the parallel-pump instability. By using a dielectric resonator, large RF magnetic field intensities can be generated using relatively low-power levels, and the presently available low-loss dielectric materials enable high Q-values to be attained in the resonator. Since the sensitivity of cavity perturbation techniques depend on high Q-values, the ferrite sphere can be made small enough so that perturbation assumptions apply. Results are presented for some representative polycrystalline samples. The largest spinwave linewidth measurement required a RF magnetic field intensity of approximately 27.0 Oe.

Abstracts

Routine to Supply Bessel Functions as Required in BASIC Programs (Computer Program Desciptions)

J.R.M. Vaughan. "Routine to Supply Bessel Functions as Required in BASIC Programs (Computer Program Desciptions)." 1970 Transactions on Microwave Theory and Techniques 18.8 (Aug. 1970 [T-MTT]): 511-512.

To provide a programmer-defined function for Bessel functions of all four kinds (J, Y, I, and K) covering the range of orders and arguments useful in microwave work, with emphasis on user convenience.

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Contributors (Aug. 1970 [T-MTT])

J.C. Beal, W.E. Courtney, W.J. Dewar, R.L. Gallawa, F.E. Gardiol, J.I. Glaser, R.J.M. Govaerts, I. Kaufman, H.A. Mendez, R.A. Moore, S.F. Payer, P.H. Pincoffs, E.O. Schulz-DuBois and A.S. Vander Vorst. "Contributors (Aug. 1970 [T-MTT])." 1970 Transactions on Microwave Theory and Techniques 18.8 (Aug. 1970 [T-MTT]): 512-514.

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Information on Computer Program Descriptions (Aug. 1970 [T-MTT])

"Information on Computer Program Descriptions (Aug. 1970 [T-MTT])." 1970 Transactions on Microwave Theory and Techniques 18.8 (Aug. 1970 [T-MTT]): 515-515.

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Parallel Pumping in Hexagonal Ferrites with the DC Field Off the Easy Plane

J. Helszajn and J. McStay. "Parallel Pumping in Hexagonal Ferrites with the DC Field Off the Easy Plane." 1970 Transactions on Microwave Theory and Techniques 18.9 (Sep. 1970 [T-MTT]): 518-524.

This paper gives the theory of spinwave instability under parallel pumping in hexagonal Zn/sub 2/Y ferrites with planar anisotropy in the case of a sphere. The configuration considered in this paper is the one in which the dc field makes an angle beta with the easy plane and the resultant magnetization lies at an angle alpha to it. To obtain parallel pumping with this arrangement it is necessfly to align the RF field along the magnetization. This leads to a new spinwave spectrometer which allows the dependence of the spinwave linewidth upon the angle alpha which the unstable spinwave makes with the c axis of the crystal to be determined. The experimental results obtained on two Mn-Zn/sub 2/Y single-crystal ferrite spheres show that the spinwave linewidth increases with the angle alpha.

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Ferrite-Junction Circulator Bibliography

R.C. Kumar. "Ferrite-Junction Circulator Bibliography." 1970 Transactions on Microwave Theory and Techniques 18.9 (Sep. 1970 [T-MTT]): 524-530.

To date an enormous amount of work has been done in the field off ferrite-junction circulators, but as yet no up-to-date bibliography is available. The present bibliography has been compiled to cover the period from January 1956 to September 1969 in order to help researchers working in this field. The bibliography provides references on ferrite circulators including entries for theory, stripline and waveguide versions, low and high powers, low-temperature circulators, lumped-element circulators, switching circulators, slot circulators, microstrip circulators, etc. It also includes references for typical designs and constructions as well as for experimental results and applications. As in the compilation of any bibliography, some valuable and pertinent article may have been overlooked.

Abstracts

Design of Transmission-Line Reactance Networks for Equalizer Applications

E.G. Cristal. "Design of Transmission-Line Reactance Networks for Equalizer Applications." 1970 Transactions on Microwave Theory and Techniques 18.9 (Sep. 1970 [T-MTT]): 531-540.

Synthesis techniques are presented for realizing arbitrary transmission-line reactance functions in four common forms of arrays of coupled lines, together with minor variations of these forms. These are two types of interdigital lines and dual forms of half-wave parallel-coupled lines. Design examples are presented for each form of coupled-line network and variations. Although the synthesis procedures are developed from the point of view of applications to equalizers, the procedures are completely general.

Abstracts

Computer-Aided Design of Broad-Band Amplifiers with Complex Loads

T.N. Trick and J. Vlach. "Computer-Aided Design of Broad-Band Amplifiers with Complex Loads." 1970 Transactions on Microwave Theory and Techniques 18.9 (Sep. 1970 [T-MTT]): 541-547.

A computer-aided design approach is developed for the analysis and design of broad-band amplifiers with complex terminations, e.g., an antenna. The transfer scattering parameters are used for the analysis of a cascade connection of distributed lines and amplifiers. A modified version of Rosenbrock's minimization procedure is used to find the optimum lengths and characteristic impedances of the lines which minimize the reflection losses and realize a desired gain characteristic. Several examples are given.

Abstracts

Wave Propagation in Hollow Conducting Elliptical Waveguides

J.G. Kretzschmar. "Wave Propagation in Hollow Conducting Elliptical Waveguides." 1970 Transactions on Microwave Theory and Techniques 18.9 (Sep. 1970 [T-MTT]): 547-554.

The propagation of electromagnetic waves in a hollow perfectly conducting pipe with an elliptical cross section and the results of numerical calculations of the cutoff wavelength of nineteen successive modes are presented. Some inaccuracies in the usual mode classification are proven and corrected. As a large number of numerical calculations are required to determine the cutoff wavelength for a single set of dimensions and a single mode, approximate formulas for the eight lowest order modes are suggested. These formulas are of a simple algebraic form and give a relative error smaller than 0.25 percent. With the exact succession of the different modes it becomes possible to compare the bandwidth of an elliptical waveguide to the bandwidth of the rectangular and circular guide. The measured values of the cutoff wavelength of different modes agree very well with the theoretical calculated values.

Abstracts

On Plane and Quasi-Optical Wave Propagation in Gyromagnetic Media

N. Eberhardt, V.V. Horvath and R.H. Knerr. "On Plane and Quasi-Optical Wave Propagation in Gyromagnetic Media." 1970 Transactions on Microwave Theory and Techniques 18.9 (Sep. 1970 [T-MTT]): 554-565.

To promote the development and understanding of microwave magnetic devices, especially in the millimeter and submillimeter range utilizing quasi-optical techniques, a discussion of propagation and polarization of plane waves and narrow rays in gyromagnetic media in an arbitrary direction is considered. It is assumed that the medium can be described by a permeability tensor of the Polder type. The approach is structured after classical crystal optics but yields significantly different results since each of the two permitted rays is elliptically polarized. The ellipticities are derived. The phase surfaces are discussed for the lossless case. There are no optical axes but ranges of forbidden directions exist for one or both rays. D, B, and the wave vector n form an orthogonal set at all times. H is confined to the B, n plane; it gyrates along an ellipse such that the Poynting vector traces in time an elliptical cone which contains the wave vector as one mantle line. Therefore, a narrow ray can be understood to proceed along a helical path.

Abstracts

Twist Modes in Magnetoplasma-Filled Circular Waveguides

K.S. Champlin and G.H. Glover. "Twist Modes in Magnetoplasma-Filled Circular Waveguides." 1970 Transactions on Microwave Theory and Techniques 18.9 (Sep. 1970 [T-MTT]): 566-570.

The properties of the axially symmetric normal modes of a circular waveguide containing an axially magnetized gas or solid-state plasma (i.e., the so-called Faraday configuration) are examined. Of particular interest is the fact that transverse electric fields demonstrate a characteristic twisting wave motion rather than the more familiar rotating motion of the circularly polarized TE°/sub 11/ limit modes or the undulating motion of the normal modes of an empty waveguide. Modes demonstrating this unique wave motion are termed "twist" modes. Within a restricted range of magnetic field, twist modes divide into evanescent (TE-limit) modes and low-loss propagating (TM-limit) modes. Since wavelengths of propagating modes depend on the axial B field, twist modes in solid-state magnetoplasmas such as InSb may find applications in magnetically tunable millimeter and submillimeter devices.

Abstracts

Investigation of "Twist" Mode Propagation in Indium Antimonide at 70 GHz

G.H. Glover and K.S. Champlin. "Investigation of "Twist" Mode Propagation in Indium Antimonide at 70 GHz." 1970 Transactions on Microwave Theory and Techniques 18.9 (Sep. 1970 [T-MTT]): 570-575.

An experimental and theoretical investigation of the propagation of axially symmetric ("twist") modes in an axially magnetized sample of indium antimonide is described. Measurements of the TE°/sub 01/-mode reflection coefficient are shown to agree well with computer calculations based upon a convergent multimode analysis. Observed maxima and minima are seen to correspond to dimensional resonances and antiresonances of the two lowest order twist modes. These results are qualitatively explained in terms of twist mode standing waves. Under certain conditions of magnetic field and sample thickness, energy conversion from the TE°/sub 01/ mode to the TM°/sub 01/ mode occurs. This conversion has a maximum calculated efficiency of 95 percent under the conditions of the present experiment.

Abstracts

A Wide-Band Variable Microwave Coupler

G. Chao. "A Wide-Band Variable Microwave Coupler." 1970 Transactions on Microwave Theory and Techniques 18.9 (Sep. 1970 [T-MTT]): 576-583.

A method is described whereby the coupling value of a TEM quarter-wave coupler can be continuously varied over ranges up to 100 percent of the nominal value. The method employs the change of even- and odd-mode characteristic impedance levels over the coupling region and as such is best suited to stripline and other configurations which use parallel ground planes as outer conductors. Because current lines are crossed only in regions of relatively low current densities and because physical realizations are mechanically simple and compact, reliability is assured. Its major disadvantage is that the voltage standing-wave ratio (VSWR) increases and the isolation decreases as the coupling is tuned away from the nominal value. However, the simple predesign procedures described in Section III can reduce or eliminate this problem. The device can be used as a variable attenuator, a variable sampler, and, in systems with couplers, a trimming device.

Abstracts

Ray Methods for Trapped and Slightly Leaky Modes in Multilayered or Multiwave Regions

S.J. Maurer and L.B. Felsen. "Ray Methods for Trapped and Slightly Leaky Modes in Multilayered or Multiwave Regions." 1970 Transactions on Microwave Theory and Techniques 18.9 (Sep. 1970 [T-MTT]): 584-595.

Ray-optical techniques presented previously by the authors for study of mode propagation in homogeneously filled waveguides are extended to accommodate multilayered regions and regions capable of supporting multiple wave species. Emphasis is placed on a self-consistent ray treatment which illustrates alternative methods for dealing with ray coupling at boundaries and with the presence of multiple wave types, either in a single layer or in adjacent regions. Both closed and open structures are analyzed, with discussion of the latter limited to modes with small leakage due either to duct inhomogeneities or to curvature. Examples include layered dielectric waveguides with a straight or circular axis, and compressible plasma waveguides which are illustrative of media wherein two wave species (electromagnetic and electroacoustic) can propagate.

Abstracts

Numerical Determination of Potential in Inhomogeneous Dielectrics by Earnshaw's Theorem

J.A. Weiss and T.G. Bryant. "Numerical Determination of Potential in Inhomogeneous Dielectrics by Earnshaw's Theorem." 1970 Transactions on Microwave Theory and Techniques 18.9 (Sep. 1970 [T-MTT]): 595-601.

Earnshaw's theorem, a characterization of potential functions equivalent to Poisson's equation, expresses a relation between the value of the potential at a point and an average of the function over a spherical surface centered at the point. The theorem therefore lends itself to use in numerical computation of the potential. A formulation of the theorem is presented with particular reference to determination of the potential in a region which is inhomogeneously occupied by dielectric media. This provides a rigorous basis for the formulas used to determine the potential at points on a dielectric interface, in that it avoids the ambiguity which arises in the evaluation of the finite-difference approximation to the Laplacian at such points. The use of the formulation is illustrated by examples of computer-generated graphs giving the potential in the presence of irregular dielectric objects.

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Effect of Top Electrode Thickness on the Performance of Microwave Acoustic Transducers

J.D. Larson, T.M. Reeder and D.K. Winslow. "Effect of Top Electrode Thickness on the Performance of Microwave Acoustic Transducers." 1970 Transactions on Microwave Theory and Techniques 18.9 (Sep. 1970 [T-MTT]): 602-608.

The effect of placing evaporated electrodes on the surface of thin-film microwave acoustic transducers is studied. In particular, it is found that the top electrode produces frequencies of infinite conversion loss (poles) within the usual operating passband of the transducer. The theory of thin-film microwave acoustic transducers is reviewed and utilized to find an analytic solution for the pole frequencies versus thickness of the top electrode. Theoretics results for Au, Ag, and Al top electrodes deposited on thin films of CdS and ZnO are presented. Experimental results for (Au/CdS), (Ag/ZnO), and (Al/ZnO) transducers are obtained by means of a novel swept-frequency pulse-echo method of measuring conversion loss. The theoretical and experimental results are found to agree within five percent. The relative advantages of transducers with the (Au/ZnO) and (Al/ZnO) configurations are compared, and designs for octave bandwidth operation are given for center frequencies ranging from 1.5 to 10 GHz.

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Radiation Losses Due to Variations of Radius on Dielectric or Optical Fibers

A.W. Snyder. "Radiation Losses Due to Variations of Radius on Dielectric or Optical Fibers." 1970 Transactions on Microwave Theory and Techniques 18.9 (Sep. 1970 [T-MTT]): 608-615.

The total loss of the HE/sub 11/ mode to the radiation field of a finite dielectric rod with small amplitude surface irregularities is considered, and a simple approximate analytic expression for radiation due to sinusoidal roughness is presented. It is shown that radiation occurs only when the frequency of surface roughness Omega is in the range beta-k/sub 2/<Omega<beta+k/sub 2/ where beta is the modal propagation constant and k/sub 2/ is the wavenumber of the surrounding medium. An analysis of isolated irregularities and a linear taper with a small change in radius are also presented.

Abstracts

Transient Analysis of Lossless Coupled Transmission Lines in a Nonhomogeneous Dielectric Medium (Sep. 1970 [T-MTT])

F.-Y. Chang. "Transient Analysis of Lossless Coupled Transmission Lines in a Nonhomogeneous Dielectric Medium (Sep. 1970 [T-MTT])." 1970 Transactions on Microwave Theory and Techniques 18.9 (Sep. 1970 [T-MTT]): 616-626.

An effective method for computing the transient response of an n-conductor transmission line system, which is characterized by multiple propagation modes of unequal phase velocities, is presented. To derive the computational algorithm, an equivalent circuit consisting of n decoupled transmission lines in conjunction with two congruence transformers was constructed and converted into two disjointed resistive n-ports. It is shown that the electrical behavior of the coupled transmission lines can be completely described in terms of the static capacitance matrices of the conductor system. The experimental results obtained on a three-conductor microstrip-printed circuit were found to be in excellent agreement with the computed results.

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Transmission through a Conducting Screen Perforated Periodically with Apertures

C.-C. Chen. "Transmission through a Conducting Screen Perforated Periodically with Apertures." 1970 Transactions on Microwave Theory and Techniques 18.9 (Sep. 1970 [T-MTT]): 627-632.

A general solution to the problem of determining first the aperture field distribution and then the transmission and reflection coefficients of an infinite planar conducting sheet perforated periodically with apertures has been formulated. The excitation is considered to be a plane wave incident at any arbitrary angle. The aperture dimensions and array element spacings were assumed to be comparable with the wavelength of the incident electromagnetic field. The solution given can include the effect of a dielectric slab used to support the thin conducting sheet. The solution is obtained by matching the tangential field components at the surface of the screen. The resulting integral equation is solved by the method of moments which reduces the integral equation to a system of linear algebraic equations that can be solved with the use of a digital computer. Accurate results for both the magnitude and phase of the aperture field distribution and the transmission coefficients for the propagating modes are determined explicitly for a specific example of slots arranged in an equilateral triangular lattice. The balance of power flow between the reflected and the transmitted waves has been checked with satisfactory results. The solution can be applied to the problem of scattering from a conducting screen with periodic apertures and to the complementary problem of scattering from a set of conducting plates by the use of Babinet's principle.

Abstracts

Tables for Asymmetric Chebyshev High-Pass TEM-Mode Directional Couplers

F. Arndt. "Tables for Asymmetric Chebyshev High-Pass TEM-Mode Directional Couplers." 1970 Transactions on Microwave Theory and Techniques 18.9 (Sep. 1970 [T-MTT]): 633-638.

Tables are presented for the design of asymmetric nonuniform-coupled transmission-line directional couplers, having a high-pass Chebyshev equal-ripple coupling response. The coefficients of the continuously tapered coupling factor represented as a polynomial of sixth order are tabulated for mean couplings of -3, -6, -8.34, -10, and -20 dB and for a given ripple of the high-pass coupling response.

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Characterization of Packaged Microwave Diodes in Reduced-Height Waveguide

J.M. Roe and F.J. Rosenbaum. "Characterization of Packaged Microwave Diodes in Reduced-Height Waveguide." 1970 Transactions on Microwave Theory and Techniques 18.9 (Sep. 1970 [T-MTT]): 638-642.

A technique for the measurement of package parasitic and equivalent-circuit parameters of microwave semiconductor devices at the frequency of operation is presented. In this method a two-port coupling circuit is found which transforms the impedance measured in rectangular waveguide to the terminals of the equivalent circuit used to represent the semiconductor device. This approach combines known properties of radial transmission lines and of impedance measurement in the TE/sub 10/-mode full-height waveguide to obtain an analytical referencing technique for a diode mounted across a reduced-height waveguide. Application of this technique is illustrated by measurements of several varactor diodes.

Abstracts

Reflection and Amplification of Acoustic Surface Waves by Interdigital Transducers with Active Circuit Loading

A.J. Bahr. "Reflection and Amplification of Acoustic Surface Waves by Interdigital Transducers with Active Circuit Loading." 1970 Transactions on Microwave Theory and Techniques 18.9 (Sep. 1970 [T-MTT]): 642-647.

It has been shown that when the reactance at the electrical port of an interdigital surface-wave transducer is tuned out, near-perfect reflection of acoustic surface waves can be obtained at either acoustic port. An inverted common-collector (ICC) transistor circuit can be used to accomplish this tuning and simultaneously generate a negative resistance that can be used to provide reflection and transmission gain for the surface waves. Some theoretical and experimental results for such a situation in the case of surface waves propagating in the Z direction on Y-cut LiNbO/sub 3/ are presented. In particular, electrically controlled variable (digital) time delay has been demonstrated using this technique.

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Abstracts

Microstrip High-Power High-Efficiency Avalanche-Diode Oscillator (Correction)

S.G. Liu. "Microstrip High-Power High-Efficiency Avalanche-Diode Oscillator (Correction)." 1970 Transactions on Microwave Theory and Techniques 18.9 (Sep. 1970 [T-MTT]): 601-601.

The abscissa scale of Fig. 6 should have read: 0.090, -0.095, 0.100, 0.105, etc., instead of 0.009, 0.09.5, 0.010, 0.0105, etc.

Abstracts

Exact Solutions of Stepped Impedance Transformers Having Maximally Flat and Chebyshev Characteristics (Comments)

R. Levy and C.S. Gledhill. "Exact Solutions of Stepped Impedance Transformers Having Maximally Flat and Chebyshev Characteristics (Comments)." 1970 Transactions on Microwave Theory and Techniques 18.9 (Sep. 1970 [T-MTT]): 648-648.

Tables for stepped impedance transformers of 5 through 10 sections appear in the above paper. The authors apparently overlook the presence of similar tables for 2 through 21 sections which were published several years ago. In the older paper the results were given for the associated distributed low-pass prototype, which, as clearly stated, is directly related to the stepped impedance transformer. This fact is common knowledge among workers in the field and has received a more detailed treatment by Cristal.

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Abstracts

Boundary Conditions for the Four Vector Potential (Correspondence)

L.F. Jelsma, E.D. Tweed, R.L. Phillips and R.W. Taylor. "Boundary Conditions for the Four Vector Potential (Correspondence)." 1970 Transactions on Microwave Theory and Techniques 18.9 (Sep. 1970 [T-MTT]): 648-650.

Boundary conditions describing perfectly conducting surfaces are developed for the four-component vector potential. The boundary conditions are nonunique and are shown to depend on the choice of the gauge. A physical interpretation is developed for the nonunique property. The results shown herein provide boundary conditions for the development of a computer approach to field problems in terms of the four-component vector potential.

Abstracts

Asymptotic Solution of Eigenvalue Equations for Surface Waveguide Structures (Correspondence)

A.W. Snyder and R. De La Rue. "Asymptotic Solution of Eigenvalue Equations for Surface Waveguide Structures (Correspondence)." 1970 Transactions on Microwave Theory and Techniques 18.9 (Sep. 1970 [T-MTT]): 650-651.

A very simple asymptotic solution to the eigenvalue equation of electromagnetic and acoustic surface waveguides is derived and shown to be accurate except where the mode has cutoff characteristics. The form of the solution is the same for both circular and planar geometries.

Abstracts

A Broad-Band Frequency Translator with 30-dB Suppression of Spurious Sidebands (Correspondence)

C.H. Grauling, Jr. and B.D. Geller. "A Broad-Band Frequency Translator with 30-dB Suppression of Spurious Sidebands (Correspondence)." 1970 Transactions on Microwave Theory and Techniques 18.9 (Sep. 1970 [T-MTT]): 651-652.

The theory and design of a broad-band microwave frequency translator using diode-switched coupled-line phase shifters is discussed. Results indicate spurious sideband suppression greater than 30 dB out to the 30th harmonic of the translation frequency.

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Abstracts

A Laminar Subsidiary-Resonance Limiter (Correspondence)

J.L. Carter and J.W. McGowan. "A Laminar Subsidiary-Resonance Limiter (Correspondence)." 1970 Transactions on Microwave Theory and Techniques 18.9 (Sep. 1970 [T-MTT]): 652-654.

An investigation of the limiting threshold in a subsidiary-resonance limiter was conducted. Particular attention was given to the effects of the demagnetizing factors on the limiting threshold. Demagnetization factors of 1/2 for N/sub x/ and N/sub y/, and 0 for N/sub z/ made it possible to achieve thresholds an order of magnitude lower than had been obtained previously. The above demagnetizing factors correspond to a long thin rod magnetized along the axis of symmetry. A limiter, utilizing alternate polycrystalline YIG rods and dielectric rods of the same dimensions for dynamic range, and alternate single-crystal YIG and dielectric rods for reduced threshold, was developed. The dielectric rods provided magnetic insulation for the ferrite material such that each ferrite rod was biased independently in order to maintain the proper demagnetizing factors. The final limiter had a threshold of 2.8 watts peak power and a dynamic range of 30 dB.

Abstracts

A Symmetrically Excited Microwave Rotary Joint (Correspondence)

D.G. de Mesquita and A.G. Bailey. "A Symmetrically Excited Microwave Rotary Joint (Correspondence)." 1970 Transactions on Microwave Theory and Techniques 18.9 (Sep. 1970 [T-MTT]): 654-656.

A waveguide rotary joint for operation in the frequency range 28-31 GHz is described. The construction of the joint is simple, as the symmetrical excitation employed for mode conversion obviates the need for mode filters. The joint may be used without tuning at certain optimum frequencies such that insertion loss is always better than 1 dB. The joint may be tuned for operation at any required frequency within the band.

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Transmission Characteristics of a Reentrant Hybrid Tee (Comments)

F.E. Gardiol and T.K. Ishii. "Transmission Characteristics of a Reentrant Hybrid Tee (Comments)." 1970 Transactions on Microwave Theory and Techniques 18.9 (Sep. 1970 [T-MTT]): 656-656.

Experimental results presented in a recent paper by Ishii and Jenners tend to show that the transmission through a reentrant hybrid tee is nonreciprocal. The derivation presented here shows that the device is always reciprocal, and that the particular effect noted in the paper under discussion was due to mismatches.

Abstracts

The Analogy of Beam Waveguides to Electric Transmission Lines (Correspondence)

J.C. Daly. "The Analogy of Beam Waveguides to Electric Transmission Lines (Correspondence)." 1970 Transactions on Microwave Theory and Techniques 18.9 (Sep. 1970 [T-MTT]): 657-658.

The propagation of beams in optical waveguide is presented in a manner that allows beam trajectories and mode parameters to be calculated using the classical transmission-line equations. Transmission-line impedance-matching techniques are applied to mode matching in optical systems.

Abstracts

A Homodyne System for the Measurement of Microwave Reflection Coefficients (Correspondence)

R.J. King and R.I. Christopherson. "A Homodyne System for the Measurement of Microwave Reflection Coefficients (Correspondence)." 1970 Transactions on Microwave Theory and Techniques 18.9 (Sep. 1970 [T-MTT]): 658-660.

The homodyne detection principle is applied to the measurement of microwave reflection coefficients. The system described is considerably more sensitive than video detection, is linear over a wide dynamic range, and allows simultaneous phase and amplitude measurements, with phase measurements amplitude insensitive. Two channels are used, one being amplitude modulated.

Abstracts

Development of an X-Band Waveguide Frequency Discriminator (Correspondence)

S.R. Mishra and R.P. Wadhwa. "Development of an X-Band Waveguide Frequency Discriminator (Correspondence)." 1970 Transactions on Microwave Theory and Techniques 18.9 (Sep. 1970 [T-MTT]): 660-661.

The development of an X-band waveguide frequency discriminator is discussed. It is quite versatile and quite simple in construction. The mid-frequency of the desired bandwidth can be conveniently changed by easily changing the additional line length. Furthermore, the sensitivity, defined as change in the output power ratio per unit change in frequency, can also be conveniently varied by varying the additional line length. Higher sensitivity would result in a smaller bandwidth for a certain value of P/sub 2/ / P/sub 1/ depending upon the accuracy with which the power/power ratio can be measured.

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Abstracts

A New Variable Microwave Attenuator (Correspondence)

R. Ekinge and T. Hedstrom. "A New Variable Microwave Attenuator (Correspondence)." 1970 Transactions on Microwave Theory and Techniques 18.9 (Sep. 1970 [T-MTT]): 661-662.

The described variable attenuator utilizes p-i-n diodes and three-port hybrids. Two arrangements of the diodes are investigated. The corresponding attenuators have basically different performances. An experimental device was built in stripline technique and a measured attenuation variable from 0 to 28 dB over the entire X-band was obtained.

Abstracts

Bounds on Output VSWR of a Passive Reciprocal Two-Port from Forward Measurements (Correspondence)

A. Uhlir, Jr.. "Bounds on Output VSWR of a Passive Reciprocal Two-Port from Forward Measurements (Correspondence)." 1970 Transactions on Microwave Theory and Techniques 18.9 (Sep. 1970 [T-MTT]): 662-663.

An inequality |S/sub 22/| is <=1-(|S/sub 21/|² / |(1+ |S/sub 11/ |)) is derived to simplify automatic testing of passive, reciprocal microwave two-ports.

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Pulse Waveform Degradation Due to Dispersion in Waveguide (Further Comments)

C.M. Knop. "Pulse Waveform Degradation Due to Dispersion in Waveguide (Further Comments)." 1970 Transactions on Microwave Theory and Techniques 18.9 (Sep. 1970 [T-MTT]): 663-665.

A concise and careful review of the Elliott analysis of how a pulsed carrier wave is distorted after propagating down a waveguide is given. This review, in conjunction with the more recent work of Haskell and Case, derives the time region for which the Elliott (corrected) solution is valid. It is shown that if the pulse contains a sufficient number of carrier cycles, and if the guide is long enough compared to a free-space wavelength at the carrier frequency, then the Elliott solution is valid for practically all times.

Abstracts

Transmission Characteristics of a Reentrant Hybrid Tee (Correspondence) (Sep. 1970 [T-MTT])

J. Clarke. "Transmission Characteristics of a Reentrant Hybrid Tee (Correspondence) (Sep. 1970 [T-MTT])." 1970 Transactions on Microwave Theory and Techniques 18.9 (Sep. 1970 [T-MTT]): 665-666.

The reentrant hybrid tee has experimentally been shown to have asymmetrical characteristics. Some theoretical comments are made on this behavior.

Abstracts

Array 1: Calculation of the Active Transmit Impedance for a Phased-Array Antenna of Lossless Elements (Computer Program Descriptions)

G.J. Laughlin. "Array 1: Calculation of the Active Transmit Impedance for a Phased-Array Antenna of Lossless Elements (Computer Program Descriptions)." 1970 Transactions on Microwave Theory and Techniques 18.9 (Sep. 1970 [T-MTT]): 666-667.

This program computes, for a phased-array antenna of lossless elements simulated in waveguide, the array-transmit impedance at the simulated scan angle.

Abstracts

Array 2: Calculation of the Active Transmit Impedance for a Phased-Array Antenna Simulated in Waveguide (Computer Program Descriptions)

G.J. Laughlin. "Array 2: Calculation of the Active Transmit Impedance for a Phased-Array Antenna Simulated in Waveguide (Computer Program Descriptions)." 1970 Transactions on Microwave Theory and Techniques 18.9 (Sep. 1970 [T-MTT]): 667-669.

This program uses aperture impedance measurements on a phased-array antenna simulated in waveguide to compute the array-transmit impedance at the simulated scan angle.

Abstracts

Q-Factor Calculations for Cylindrical Microwave Resonators (Computer Program Descriptions)

I.R. Dagg, A.M. Muc and G.E. Reesor. "Q-Factor Calculations for Cylindrical Microwave Resonators (Computer Program Descriptions)." 1970 Transactions on Microwave Theory and Techniques 18.9 (Sep. 1970 [T-MTT]): 669-669.

This program calculates and prints the values of form factor and Q of cylindrical resonators for all desired modes in the 100 lowest orders. Frequency range, cavity parameters, and required modes are all user specified.

Abstracts

Contributors (Sep. 1970 [T-MTT])

F. Arndt, A.J. Bahr, T.G. Bryant, K.S. Champlin, F.-Y. Chang, G. Chao, C.-C. Chen, E.G. Cristal, N. Eberhardt, L.B. Felsen, G.H. Glover, J. Helszajn, V.V. Horvath, R.H. Knerr, J.G. Kretzschmar, R.C. Kumar, J.D. Larson, S.J. Maurer, J. McStay, T.M. Reeder, J.M. Roe, F.J. Rosenbaum, A.W. Snyder, T.N. Trick, J. Vlach, J.A. Weiss and D.K. Winslow. "Contributors (Sep. 1970 [T-MTT])." 1970 Transactions on Microwave Theory and Techniques 18.9 (Sep. 1970 [T-MTT]): 670-674.

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Microwave Abstracts (Sep. 1970 [T-MTT])

"Microwave Abstracts (Sep. 1970 [T-MTT])." 1970 Transactions on Microwave Theory and Techniques 18.9 (Sep. 1970 [T-MTT]): 674-675.

Based on technical merit and timeliness, microwave papers in journals published outside the United States have been selected and compiled below, generally with brief abstracts. Reprints of the papers may be obtainable by writing directly to the author or to the source quoted.

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Special Issue on Active and Digital Networks (Announcement) (Sep. 1970 [T-MTT])

"Special Issue on Active and Digital Networks (Announcement) (Sep. 1970 [T-MTT])." 1970 Transactions on Microwave Theory and Techniques 18.9 (Sep. 1970 [T-MTT]): 676-676.

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"Symposium Digest Order Blank (Sep. 1970 [T-MTT])." 1970 Transactions on Microwave Theory and Techniques 18.9 (Sep. 1970 [T-MTT]): 679-679.

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Membership Application (Sep. 1970 [T-MTT])

"Membership Application (Sep. 1970 [T-MTT])." 1970 Transactions on Microwave Theory and Techniques 18.9 (Sep. 1970 [T-MTT]): 680-680.

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"Front Cover (Oct. 1970 [T-MTT])." 1970 Transactions on Microwave Theory and Techniques 18.10 (Oct. 1970 [T-MTT]): f1-f2.

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Abstracts

N-Way TEM-Mode Broad-Band Power Dividers

H.Y. Yee, F.-C. Chang and N.F. Audeh. "N-Way TEM-Mode Broad-Band Power Dividers." 1970 Transactions on Microwave Theory and Techniques 18.10 (Oct. 1970 [T-MTT]): 682-688.

An integrative graphical method of designing a broadband TEM-mode power divider of N output ports is presented. Each branch of the divider's circuit consists of cascaded transmission-line segments, and the corresponding segments of each branch are connected by resistors to a common junction. These resistors absorb the reflected signals due to mismatch at any of the output ports; they are therefore isolated from one another. The symmetry of this circuit permits the use of the method of even- and odd-mode excitations at the output ports. It was found that the even-mode circuit is the same as for a stepped-impedance transformer, which is well known. The odd-mode circuit lends itself to the determination of the isolation resistors using the iterative graphical procedure on a Smith chart. Numerical values of the isolation conductance for dividers of bandwidths up to 10:1, the maximum input VSWR, and the minimum isolation among the output ports are given.

Abstracts

Influence of Wall Losses on Energy Flow Center Velocity of Pulses in Waveguides

J.L. Klapka. "Influence of Wall Losses on Energy Flow Center Velocity of Pulses in Waveguides." 1970 Transactions on Microwave Theory and Techniques 18.10 (Oct. 1970 [T-MTT]): 689-696.

A rectangular carrier pulse is studied under the assumption of the propagation of a pure basic mode in a circular waveguide with low wall losses. An analytical expression of the electromagnetic field of an output pulse and an analytical expression of, the velocity with which the temporal center of gravity of the axial component of the Poynting vector of a pulse is traveling in a waveguide were derived for a not very high ratio of the input-pulse carrier frequency to the cutoff frequency of the given mode. A dependence is found of the above velocity on the wall losses, on the distance from the source, and on the duration time of the input pulse. The relation is found between the above velocity and the instantaneous phase velocity in the above center of gravity. The results obtained can be of importance in nanosecond pulse technique or for long-distance transfer of the pulses.

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Waves and Evanescent Fields in Rectangular Waveguides Filled with a Transversely Inhomogeneous Dielectric

W. Baier. "Waves and Evanescent Fields in Rectangular Waveguides Filled with a Transversely Inhomogeneous Dielectric." 1970 Transactions on Microwave Theory and Techniques 18.10 (Oct. 1970 [T-MTT]): 696-705.

A numerical-calculation method for rectangular waveguides containing a transversely inhomogeneous dielectric is presented. The method is not restricted to the cutoff case or to special inhomogeneities. The relative permittivity of the dielectric can be an arbitrary function of the cross-sectional coordinates. The electric-and magnetic-field strengths, the dispersion characteristics of the propagating modes, and the attenuation constants of the evanescent modes result from the solution of a matrix eigenvalue problem with typically 8000 matrix elements. Propagating and evanescent modes in a waveguide containing a longitudinal semicircular dielectric rod are calculated as examples. The accuracy of the calculation method is confirmed by measurements and by calculating a special example with an exactly known solution. The error of the field intensities is typically 5 percent; the error of the dispersion characteristics and of the attenuation constants is typically 0.5 percent.

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The Adjustment of the m-Port Single-Junction Circulator

J. Helszajn. "The Adjustment of the m-Port Single-Junction Circulator." 1970 Transactions on Microwave Theory and Techniques 18.10 (Oct. 1970 [T-MTT]): 705-711.

The purpose of this paper is to present a systematic procedure for the adjustment of the m-port single-junction circulator in terms of the scattering-matrix eigenvalues of the junction. The theory used starts by defining the initial location of the scattering-matrix eigenvalues before any adjustment to the junction is made and also by defining the eigenvalue arrangement of an ideal circulator. The initial set of eigenvalues is then perturbed in a systematic way by adjusting the phases of (m-1) of the eigenvalues one at a time until the final set of eigenvalues is obtained. This procedure leads to (m-1) distinct scattering matrices which can be obtained with (m-1) symmetric perturbations of the junction. This approach also leads to (m-1) distinct boundary-value problems each involving one independent variable instead of the more usual single-boundary problem involving (m-1) independent variables.

Abstracts

Measurement of AM Noise in Pulsed Oscillators and Amplifiers

P.A. Levine. "Measurement of AM Noise in Pulsed Oscillators and Amplifiers." 1970 Transactions on Microwave Theory and Techniques 18.10 (Oct. 1970 [T-MTT]): 712-715.

The noise properties of amplifiers and oscillators are critical in systems applications. This paper describes a system for the measurement of AM noise in amplifiers and oscillators pulsed on for durations on the order of a microsecond or less. Such a system is useful in measuring AM noise in pulsed solid-state microwave devices such as avalanche- and Gunn-diode simplifiers and oscillators, where heat-dissipation limitations sometimes make continuous operation impossible.

Abstracts

The Precision Measurement of Noise Temperature of Mismatched Noise Generators

D.F. Wait. "The Precision Measurement of Noise Temperature of Mismatched Noise Generators." 1970 Transactions on Microwave Theory and Techniques 18.10 (Oct. 1970 [T-MTT]): 715-724.

By refining the technique and analysis of an earlier paper, it is shown that a compensation method is the basis of the most precise measurement of noise temperature, especially for cryogenic noise generators. The measurement system is adjusted so that it is in thermal equilibrium with the generator under test. As is typical for the compensation method, the generator under test may be mismatched, and the comparison errors and detector limitations can be verified experimentally. For generators with small reflection coefficients (|Gamma| <= 0.1), the comparison error is very close to the theoretical minimum, namely, twice the system resolution. For reflection coefficients as large as 0.5, the comparison error increases in a typical system to about four times the system resolution.

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Variational Bound Principle for Scattering of Electromagnetic Waves by Obstacles in a Waveguide

I. Aronson, K. Kalikstein, C.J. Kleinman and L. Spruch. "Variational Bound Principle for Scattering of Electromagnetic Waves by Obstacles in a Waveguide." 1970 Transactions on Microwave Theory and Techniques 18.10 (Oct. 1970 [T-MTT]): 725-731.

A formulation is presented for the determination of variational bounds on the even and odd phase shifts that characterize the scattering of electromagnetic waves by symmetric dielectric obtacles in waveguides. The formulation is an extension of a technique recently developed in quantum mechanical scattering theory for the determination of variations bounds on partial-wave phase shifts for scattering by systems with internal degrees of freedom. As opposed to the usual variational principles which give values that may be below or above the true values, the formalism presented here gives results that are variational and represent rigorous bounds on the true values. The formulation is presented for a more general case, but for simplicity the method is applied to scattering from dielectric obstacles in a rectangular waveguide in which only the TE/sub 10/ mode is propagated. The method involves the use of a trial function orthogonal to the lowest mode with variational parameters and the introduction of a Green's function for a simplified problem in which the higher modes cannot be excited. Calculated values are presented for the phase shifts for the true problem and also for the series and shunt reactance of the equivalent network. The principle can be generalized to multimode waveguide problems.

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Frequency Dependence of a Coupled Pair of Microstrip Lines (Correspondence)

E.J. Denlinger. "Frequency Dependence of a Coupled Pair of Microstrip Lines (Correspondence)." 1970 Transactions on Microwave Theory and Techniques 18.10 (Oct. 1970 [T-MTT]): 731-733.

A Fourier-transform method is used for determining the frequency dependence of the transmission parameters for coupled micro strip lines. Experimental measurements of the even- and odd-mode velocities are described for substrates made of dielectric as well as demagnetized ferrite. The results show a significant difference in the amount of dispersion of the two normal modes of propagation.

Abstracts

C-Band Ultrasonic Delay Line Using Mode Conversion in YAG (Correspondence)

A.B. Smith. "C-Band Ultrasonic Delay Line Using Mode Conversion in YAG (Correspondence)." 1970 Transactions on Microwave Theory and Techniques 18.10 (Oct. 1970 [T-MTT]): 733-734.

A delay line is described which uses longitudinal-to-shear wave conversion to achieve low acoustic loss in YAG with CdS transducers. This device provides 4 µs of delay at 5 GHz with a 6-dB bandwidth of /spl sim/1.3 GHz and an insertion loss of /spl sim/65 dB.

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Scattering of a Shielded Surface Wave by a Wall-Impedance Discontinuity (Correspondence)

R.K. Arora and S. Vijayaraghavan. "Scattering of a Shielded Surface Wave by a Wall-Impedance Discontinuity (Correspondence)." 1970 Transactions on Microwave Theory and Techniques 18.10 (Oct. 1970 [T-MTT]): 734-736.

The Wiener-Hopf technique is used to compute the transmission and reflection coefficients of a shielded surface wave in a parallel-plate waveguide consisting of inductively reactive guiding surfaces and characterized by an abrupt wall-reactance discontinuity.

Abstracts

Loss Calculations for Rectangular Coupled Bars (Correspondence)

M.C. Horton. "Loss Calculations for Rectangular Coupled Bars (Correspondence)." 1970 Transactions on Microwave Theory and Techniques 18.10 (Oct. 1970 [T-MTT]): 736-738.

By using slope information obtained from Getsinger's or Gupta's charts, it is possible to calculate incidental loss in TEM coupled-line sections using the equation for alpha/sub cc/ given in this correspondence. This value of loss factor can then be used to calculate incidental loss in components that include coupled-line sections for which Z/sub 0/² = Z/sub 0e/Z/sub 0o/, such as 90° backward-wave couplers and microwave C sections. An example calculation is given for a single-section 90° coupler.

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A Simple Method for Obtaining the System Function of a Cascade Connection of Transmission Lines (Correspondence)

G.F. Ross. "A Simple Method for Obtaining the System Function of a Cascade Connection of Transmission Lines (Correspondence)." 1970 Transactions on Microwave Theory and Techniques 18.10 (Oct. 1970 [T-MTT]): 738-740.

A method is presented for finding, by inspection, the system function (i.e., the Laplace transform of the impulse response) of a cascade connection of equal-length TEM-mode transmission lines.

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Numerical Formation of Finite-Difference Operators (Correspondence)

P. Silvester. "Numerical Formation of Finite-Difference Operators (Correspondence)." 1970 Transactions on Microwave Theory and Techniques 18.10 (Oct. 1970 [T-MTT]): 740-743.

A matrix formulation is given for the classical Taylor's series method of approximating differential operators by finite differences. This formulation lends itself to digital computation, so that automatic generation of finite-difference formulas becomes possible. A program to perform this task has been written and tested, with good results for those operators of particular interest in microwave theory (Laplace's, Helmholtz's, and related types). Following a brief description of the program, its use is illustrated for the case of the scalar axisymmetric Laplacian. It is concluded that a wide variety of special finite-difference operators such as recently devised for specific microwave problems can now be generated automatically.

Abstracts

Low-Loss Cryogenic L-Band Circulator (Correspondence)

J. Edrich and R.G. West. "Low-Loss Cryogenic L-Band Circulator (Correspondence)." 1970 Transactions on Microwave Theory and Techniques 18.10 (Oct. 1970 [T-MTT]): 743-745.

It is shown that a three-port stripline circulator can be constructed to operate in Z-band at 15°K with 0.5 dB insertion loss and up to 20-percent bandwidth for the 20-dB isolation.

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I. Aronson, N.F. Audeh, W. Baier, F.-C. Chang, J. Helszajn, K. Kalikstein, J.L. Klapka, C.J. Kleinman, P.A. Levine, L. Spruch, D.F. Wait and H.Y. Yee. "Contributors (Oct. 1970 [T-MTT])." 1970 Transactions on Microwave Theory and Techniques 18.10 (Oct. 1970 [T-MTT]): 745-746.

Abstracts

Microwave Abstracts (Oct. 1970 [T-MTT])

"Microwave Abstracts (Oct. 1970 [T-MTT])." 1970 Transactions on Microwave Theory and Techniques 18.10 (Oct. 1970 [T-MTT]): 747-747.

Based on technical merit and timeliness, microwave papers in journals published outside the United States have been selected and compiled below, generally with brief abstracts. Reprints of the papers may be obtained by writing directly to the author or to the source quoted.

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Information on Computer Program Descriptions (Oct. 1970 [T-MTT])

"Information on Computer Program Descriptions (Oct. 1970 [T-MTT])." 1970 Transactions on Microwave Theory and Techniques 18.10 (Oct. 1970 [T-MTT]): 748-748.

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Front Cover (Nov. 1970 [T-MTT])

"Front Cover (Nov. 1970 [T-MTT])." 1970 Transactions on Microwave Theory and Techniques 18.11 (Nov. 1970 [T-MTT] (Special Issue on Microwave Circuit Aspects of Avalanche-Diode and Transferred Electron Devices)): f1-f2.

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"Table of Contents (Nov. 1970 [T-MTT])." 1970 Transactions on Microwave Theory and Techniques 18.11 (Nov. 1970 [T-MTT] (Special Issue on Microwave Circuit Aspects of Avalanche-Diode and Transferred Electron Devices)): 749-749.

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Editor's Note (Nov. 1970 [T-MTT])

G.I. Haddad. "Editor's Note (Nov. 1970 [T-MTT])." 1970 Transactions on Microwave Theory and Techniques 18.11 (Nov. 1970 [T-MTT] (Special Issue on Microwave Circuit Aspects of Avalanche-Diode and Transferred Electron Devices)): 750-750.

Avalanche diodes and transferred electron devices are now established as reliable microwave devices which can perform many functions including generation, amplification, and detection of electromagnetic energy at microwave and millimeter-wave frequencies. Because of their potential low cost, these devices should be useful in many commercial applications. Besides communications such applications include intrusion alarms; speedometers; collision-avoidance radars for automobiles, trains, and aircraft; and others.

Abstracts

Introduction (Nov. 1970 [T-MTT])

A.H. Solomon. "Introduction (Nov. 1970 [T-MTT])." 1970 Transactions on Microwave Theory and Techniques 18.11 (Nov. 1970 [T-MTT] (Special Issue on Microwave Circuit Aspects of Avalanche-Diode and Transferred Electron Devices)): 750-751.

After more than five years of intensive research and development, avalanche diodes and transferred electron devices are established as useful and reliable microwave power generators. They have recently been employed increasingly in both military and commercial systems. Many manufacturers now have production capabilities for these devices, and fabrication technology has reached a sophisticated level. Volume production at relatively low cost is now feasible. Avalanche diodes and transferred electron devices now compete favorably on a cost and performance basis with vacuum tubes and solid-state harmonic generators in a wide variety of power-generation applications.

Abstracts

Basic Principles and Properties of Avalanche Transit-Time Devices

G.I. Haddad, P.T. Greiling and W.E. Schroeder. "Basic Principles and Properties of Avalanche Transit-Time Devices." 1970 Transactions on Microwave Theory and Techniques 18.11 (Nov. 1970 [T-MTT] (Special Issue on Microwave Circuit Aspects of Avalanche-Diode and Transferred Electron Devices)): 752-772.

The basic principles and characteristics of the various modes of operation of avalanche transit-time devices are presented. Theoretical and experimental results are also presented in order to indicate the present state of development and the kind of performance which has been achieved in these devices.

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Abstracts

Transferred Electron Amplifiers and Oscillators

S.Y. Narayan and F. Sterzer. "Transferred Electron Amplifiers and Oscillators." 1970 Transactions on Microwave Theory and Techniques 18.11 (Nov. 1970 [T-MTT] (Special Issue on Microwave Circuit Aspects of Avalanche-Diode and Transferred Electron Devices)): 773-783.

The current status of transferred electron devices (TEDs) is surveyed. The physics of the transferred electron effect, the theory of amplifiers and oscillators, material growth, device fabrication, and the design of amplifier and oscillator circuits are discussed along with a presentation of the outlook for the near future.

Abstracts

Broad-Band Equivalent-Circuit Determination of Gunn Diodes

I.W. Pence, Jr. and P.J. Khan. "Broad-Band Equivalent-Circuit Determination of Gunn Diodes." 1970 Transactions on Microwave Theory and Techniques 18.11 (Nov. 1970 [T-MTT] (Special Issue on Microwave Circuit Aspects of Avalanche-Diode and Transferred Electron Devices)): 784-790.

A method has been developed for the direct broad-band measurement of the impedance of a Gunn diode operating at a bias voltage exceeding threshold. This method is based upon determination of an equivalent-circuit model for the diode mount and package, which is found to be valid over the 1- to 20-GHz range. Using this circuit, the low-field diode equivalent circuit is found and takes the form of a parallel RC circuit as expected from the theory. An unusual result is that the low-field capacitance is found to be strongly dependent on the bias voltage; this dependence is presumed due to the free-carrier contribution to the effective dielectric constant. Some direct broad-band measurements are reported for an active Gunn diode biased beyond threshold. These measurements provide additional insight into the conditions under which significant parametric action may occur in a Gunn diode.

Abstracts

Microwave Equivalent-Circuit Parameters of Gunn-Effect-Device Packages

R.P. Owens and D. Cawsey. "Microwave Equivalent-Circuit Parameters of Gunn-Effect-Device Packages." 1970 Transactions on Microwave Theory and Techniques 18.11 (Nov. 1970 [T-MTT] (Special Issue on Microwave Circuit Aspects of Avalanche-Diode and Transferred Electron Devices)): 790-798.

The packages in which Gunn-effect devices are commonly mounted are found to have parasitic reactances which are significant at X-band. An accurate knowledge of the package equivalent circuit is essential. Precision measurements in a coaxial system have therefore been made over a very wide range of frequencies, and a consistent equivalent circuit has been derived. This differs somewhat from previously assumed equivalent circuits. The experimental results are analyzed in terms of a theoretical model based on the known structure of the package.

Abstracts

Frequency-Saturation Effects in Transferred Electron Oscillators

B.C. Taylor, S.J. Fray and S.E. Gibbs. "Frequency-Saturation Effects in Transferred Electron Oscillators." 1970 Transactions on Microwave Theory and Techniques 18.11 (Nov. 1970 [T-MTT] (Special Issue on Microwave Circuit Aspects of Avalanche-Diode and Transferred Electron Devices)): 799-807.

Frequency-saturation effects have been observed in the mechanical tuning characteristics of transferred electron (Gunn) oscillators operating in conventional waveguide cavities at frequencies from 12 to 40 GHz. Their existence leads to a restriction in oscillator tuning range and enhances frequency switching and hysteresis effects in the oscillators. Investigation of oscillator behavior in coaxial cavities as well as in waveguide cavities of varying height has shown that frequency saturation is caused by a coaxial resonance along the mounting post, which in the limit of fully reduced-height waveguide becomes the resonance of the diode with the encapsulation itself, or by a frequency limitation imposed by the diode thickness and operating voltage. The transverse coaxial resonance will occur in any waveguide size at a frequency near to if not within the band of interest. Simulation of the encapsulated diode by a localized reduction in mounting-post diameter shows that the frequency of transverse resonance can be increased by moving the encapsulation to a central position in the waveguide cross section. It is suggested that this technique and that of using cavities with a local reduction of height will make an important contribution to improving the performance characteristics of waveguide-mounted oscillators.

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Circuit Analysis of Waveguide-Cavity Gunn-Effect Oscillator

W.-C. Tsai, F.J. Rosenbaum and L.A. MacKenzie. "Circuit Analysis of Waveguide-Cavity Gunn-Effect Oscillator." 1970 Transactions on Microwave Theory and Techniques 18.11 (Nov. 1970 [T-MTT] (Special Issue on Microwave Circuit Aspects of Avalanche-Diode and Transferred Electron Devices)): 808-817.

A simple equivalent circuit using lumped constant elements is developed for the post-coupled-waveguide-cavity Gunn effect oscillator. The circuit is used to predict with high accuracy the tuning characteristics, loaded Q, and mode-switching frequencies for the oscillator. Characteristic capacitance and negative-resistance values for low-n/sub 0/L-product CW devices are also presented.

Abstracts

Load Dependence of Gunn-Oscillator Performance

H. Pollmann, R. Engelmann, W. Frey and B.G. Bosch. "Load Dependence of Gunn-Oscillator Performance." 1970 Transactions on Microwave Theory and Techniques 18.11 (Nov. 1970 [T-MTT] (Special Issue on Microwave Circuit Aspects of Avalanche-Diode and Transferred Electron Devices)): 817-827.

A detailed analysis of an experimental resonator as a basis for determining the output power and the tuning range of Gunn oscillators as functions of the fundamental resonant-load resistance. Differing n/sub 0/L products (1.2 and 4.8x10/sup 12/ cm/sup -2/) lead to strikingly different results which are related to the delayed-and quenched-domain resonant modes, respectively. Variations of the second-harmonic frequency termination cause the fundamental output power of Gunn oscillators to change by a factor of up to 5, this change being accompanied by a frequency pulling of a few percent. From detailed impedance measurements it is concluded that the maximum fundamental power occurs if the second-harmonic circuit is tuned near an open-circuit resonance, the total circuit susceptance being somewhat capacitive.

Abstracts

Microwave Circuits for High-Efficiency Operation of Transferred Electron Oscillators

J.F. Reynolds, B.E. Berson and R.E. Enstrom. "Microwave Circuits for High-Efficiency Operation of Transferred Electron Oscillators." 1970 Transactions on Microwave Theory and Techniques 18.11 (Nov. 1970 [T-MTT] (Special Issue on Microwave Circuit Aspects of Avalanche-Diode and Transferred Electron Devices)): 827-834.

Compact circuits for obtaining high-efficiency operation of high-power transferred electron oscillators (TEOs) in L-band are described. One is a coaxial resonator and the other employs coupled TEM lines. The circuits are shown analytically and experimentally to be capable of matching a wide range of fundamental device impedances. Provisions for independently tuning the second-harmonic impedance over a wide range are included in both types of circuits. Pulsed conversion efficiencies up to 32 percent have been obtained TEOs mounted in the coaxial resonators and up to 27 percent with TEOs in the coupled TEM-line structures. The impedance at the second harmonic has been shown quantitatively to be extremely important in controlling device efficiency. By varying the second-harmonic tuning the device performance can be varied from high-efficiency operation to no output. Oscillators using these cavities were temperature stable over a wide range. The operating frequency of TEOs in the coaxial cavity and the coupled-TEM-line cavity varied less than 30 and 40 kHz/°C, respectively, over the range from - 54°C to +125°C.

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State-Space Analysis of General IMPATT Diode Small-Signal Lumped Models

J.A.C. Stewart, D.R. Conn and H.R. Mitchell. "State-Space Analysis of General IMPATT Diode Small-Signal Lumped Models." 1970 Transactions on Microwave Theory and Techniques 18.11 (Nov. 1970 [T-MTT] (Special Issue on Microwave Circuit Aspects of Avalanche-Diode and Transferred Electron Devices)): 835-842.

The development of a lumped model for small-signal carrier-field interactions in an IMPATT diode results in a set of state equations. Using state-space analysis techniques, the equations are solved for the small-signal impedance of a general IMPATT diode as a function of dc bias current and frequency. Read, p-n, and p-i-n diodes are studied using realistic values for saturation carrier velocities and carrier-ionization rates. Curves indicating the influence of diode physical properties on the small-signal impedance are presented. By combining state equations describing the behavior of the external microwave circuit with the diode state equations, the small-signal oscillation frequency and threshold dc bias current of a coaxial IMPATT oscillator are determined.

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Large-Signal Equivalent Circuits of Avalanche Transit-Time Devices

P.T. Greiling and G.I. Haddad. "Large-Signal Equivalent Circuits of Avalanche Transit-Time Devices." 1970 Transactions on Microwave Theory and Techniques 18.11 (Nov. 1970 [T-MTT] (Special Issue on Microwave Circuit Aspects of Avalanche-Diode and Transferred Electron Devices)): 842-853.

A large-signal analysis for IMPATT diodes is derived, which allows carrier multiplication by impact ionization to occur at every point in the diode. Therefore, the operating characteristics of IMPATT diodes with a wide range of realistic doping profiles can be investigated. For a given operating frequency, RF voltage, dc bias current, and doping profile, the admittance, power output, efficiency, bias voltage of a diode can be obtained. An equivalent circuit the diode package, microwave circuit mount and diode, is obtained experimentally. Using this circuit, the admittance of the diode is measured by a reflection-type circuit and an oscillator circuit as a function of the RF voltage, dc bias current, and frequency.

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Characterization of Nonlinear Interactions in Avalanche Transit-Time Oscillators, Frequency Multipliers, and Frequency Dividers

K. Mouthaan. "Characterization of Nonlinear Interactions in Avalanche Transit-Time Oscillators, Frequency Multipliers, and Frequency Dividers." 1970 Transactions on Microwave Theory and Techniques 18.11 (Nov. 1970 [T-MTT] (Special Issue on Microwave Circuit Aspects of Avalanche-Diode and Transferred Electron Devices)): 853-862.

Equivalent circuits are introduced for nonlinear operation of the avalanche transit-time diode at a single frequency and at two harmonically related frequencies. Parameters are derived that characterize the nonlinear interaction between the diode and the associated microwave circuit. Particular attention is devoted to the oscillator, the frequency multiplier, and the frequency divider. For the oscillator, parametric interaction with a harmonic of the desired oscillation frequency is shown to give possibilities of enhancing the output power and of significantly improving the noise performance. An experimental two-frequency oscillator is described that has confirmed the theoretical predictions.

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Computer Experiments on TRAPATT Diodes

W.J. Evans. "Computer Experiments on TRAPATT Diodes." 1970 Transactions on Microwave Theory and Techniques 18.11 (Nov. 1970 [T-MTT] (Special Issue on Microwave Circuit Aspects of Avalanche-Diode and Transferred Electron Devices)): 862-871.

Simplified analytical treatments of the TRAPATT mode of operation in avalanche diodes do not consider in sufficient detail the initial starting conditions for this mode. This paper examines this question in greater detail by analyzing a number of diode structures using a large-scale computer program. The results of these computer experiments have indicated that the requirements for efficient TRAPATT operation and the requirements for IMPATT operation diverge with increasing frequency. Since the IMPATT oscillation is required to start the TRAPATT mode, self-starting TRAPATT oscillators are increasingly difficult to fabricate as the operating frequency is increased. A novel diode structure is proposed which eliminates this problem and is capable of high-frequency CW TRAPATT operation.

Abstracts

Large-Signal Silicon and Germanium Avalanche-Diode Characteristics

D.R. Decker, C.N. Dunn and R.L. Frank. "Large-Signal Silicon and Germanium Avalanche-Diode Characteristics." 1970 Transactions on Microwave Theory and Techniques 18.11 (Nov. 1970 [T-MTT] (Special Issue on Microwave Circuit Aspects of Avalanche-Diode and Transferred Electron Devices)): 872-876.

A technique for measurement of the large-signal single-frequency microwave amplifier admittance of avalanche diodes is described, and results are presented for silicon and germanium avalanche diodes. Single-frequency amplifier operation can provide a unique characterization of diode-admittance variation with RF drive for diodes operated near the optimum transit angle (the case in which all harmonic voltages are negligibly small compared to the fundamental). Such characterization is useful for predicting diode performance for circuits in which the harmonic voltages are not large enough to have an appreciable effect on the diode admittance at the fundamental frequency. A process of matching quadratic forms to the above admittance data which may be used for calculation of diode terminal admittance and power output is discussed. The usefulness of the measurement technique is illustrated by the agreement of the calculated maximum power output with the measured power output in a single-transformer coaxial circuit. The corresponding circuit admittance may be used for circuit-design purposes and for evaluating variations in diode-assembly techniques. The ability to obtain the diode equivalent circuit as a function of incident power allows studies in the design of the associated semiconductor device. For example, one has the capability of obtaining an accurate single-frequency large-signal model near the optimum transit angle, a model which can be studied without building a circuit. With this model it is possible to carry out optimization procedures at considerable savings of time and money.

Abstracts

Amplitude and Frequency Modulation of a Waveguide Cavity CW Gunn Oscillator

W.C. Tsai and F.J. Rosenbaum. "Amplitude and Frequency Modulation of a Waveguide Cavity CW Gunn Oscillator." 1970 Transactions on Microwave Theory and Techniques 18.11 (Nov. 1970 [T-MTT] (Special Issue on Microwave Circuit Aspects of Avalanche-Diode and Transferred Electron Devices)): 877-884.

The characteristics of bias-voltage-controlled AM and FM of a CW Gunn oscillator are reported. It is found that the loaded Q of the microwave oscillator circuit and the microwave impedance level largely govern these characteristics. Modulation mechanisms are discussed. A particular mechanism, due to the nonlinear I-V curve of the device, is shown to lower the oscillating frequency as the bias voltage is increased. Performance of an automatic frequency control loop (AFC) is also described.

Abstracts

Highly Stabilized Half-Watt IMPATT Oscillator (Nov. 1970 [T-MTT])

S. Nagano and H. Kondo. "Highly Stabilized Half-Watt IMPATT Oscillator (Nov. 1970 [T-MTT])." 1970 Transactions on Microwave Theory and Techniques 18.11 (Nov. 1970 [T-MTT] (Special Issue on Microwave Circuit Aspects of Avalanche-Diode and Transferred Electron Devices)): 885-890.

An X-band IMPATT oscillator having a stabilized output power of over 0.5 watt has been developed. The oscillator consists of a main cavity and a directly coupled reaction-type cavity for stabilization. The oscillator has a frequency stability of 2.6x10/sup -5/ over a temperature variation ranging from 0° to 50°C and an rms noise deviation of 15 Hz/1-kHz bandwidth at 500 kHz from the carrier. Design considerations have been made concerning the admittance characteristics of the circuit and of the diode to determine preferable circuit conditions for stabilization. The output-power loss due to the stabilization is as small as 0.4 dB. The oscillator is capable of operation in a frequency range of 10.7 to 11.7 GHz.

Abstracts

Cavity Stabilized X-Band Gunn Oscillator (Nov. 1970 [T-MTT])

Y. Ito, H. Komizo and S. Sasagawa. "Cavity Stabilized X-Band Gunn Oscillator (Nov. 1970 [T-MTT])." 1970 Transactions on Microwave Theory and Techniques 18.11 (Nov. 1970 [T-MTT] (Special Issue on Microwave Circuit Aspects of Avalanche-Diode and Transferred Electron Devices)): 890-897.

The design and resultant experimental investigation of a pulling mechanism for a highly stable X-band Gunn oscillator, stabilized by a high Q TE/sub 011/-mode reflection cavity, are described. The oscillator shows a temperature coefficient of less than -7 x 10/sup -7/ / °C, a low FM noise of 8 Hz per 1-kHz BW at 100 kHz from the carrier, and a wide-band mechanical-tuning capability of several hundred megahertz. In addition, experimental results concerning the hysteresis phenomena of oscillating frequencies, power, FM-noise versus cavity-pulling frequencies, and bias voltages are described.

Abstracts

Amplitude Behavior of Injection-Locked Oscillators

T.L. Osborne. "Amplitude Behavior of Injection-Locked Oscillators." 1970 Transactions on Microwave Theory and Techniques 18.11 (Nov. 1970 [T-MTT] (Special Issue on Microwave Circuit Aspects of Avalanche-Diode and Transferred Electron Devices)): 897-905.

Subject to a reasonable constraint on the frequency of the amplitude modulation of the injected signal, the reduced amplitude equation for an injection-locked oscillator, a nonlinear differential equation, is reduced to a nonlinear algebraic equation which is solved numerically. AM limiting, power limiting, and output-power increment are calculated as functions of injected-signal amplitude for several types of negative-conductance nonlinearities. A method of characterizing the conductance nonlinearity from the measured output-power increment is given and is used to characterize avalanche- and tunnel-diode oscillators. Excellent agreement between calculated and measured limiting is shown. In addition to clarifying the amplitude behavior of the locked oscillator, the results show what types of nonlinearities are desirable for limiter applications, that avalanche-diode oscillators have the potential for excellent limiting, and that the output-power increment is indicative of the oscillator impedance match.

Abstracts

Power Amplification for FM and PM Signals with Synchronized IMPATT Oscillators

T. Isobe and M. Tokida. "Power Amplification for FM and PM Signals with Synchronized IMPATT Oscillators." 1970 Transactions on Microwave Theory and Techniques 18.11 (Nov. 1970 [T-MTT] (Special Issue on Microwave Circuit Aspects of Avalanche-Diode and Transferred Electron Devices)): 906-911.

To meet certain requirements for system performance such as broadening the bandwidth, obtaining a high gain for the FM-and PM-signal amplifier, and increasing the power output, the "locking amplifier" composed of cascade-connected and hybrid-combined synchronizing oscillators is described. How the SNR of the amplifier is greatly improved and its gain increased by cascade connection and hybrid combination is discussed. These have been ascertained by experiments. In addition, another broad-band and high-gain synchronizing circuit and its application to pulse code modulation-phase modulation (PCM-PM) signal amplification are also discussed.

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Wide-Band Reflection-Type Transferred Electron Amplifiers

B.S. Perlman, C.L. Upadhyayula and R.E. Marx. "Wide-Band Reflection-Type Transferred Electron Amplifiers." 1970 Transactions on Microwave Theory and Techniques 18.11 (Nov. 1970 [T-MTT] (Special Issue on Microwave Circuit Aspects of Avalanche-Diode and Transferred Electron Devices)): 911-921.

Stable CW and pulsed linear-reflection-type amplification at C- and X-band frequencies using epitaxial-GaAs transferred electron devices is described. These devices have a doping density-length product (nl) greater than 5 x 10/sup 11/cm/sup -2/. Criteria for avoiding the normal instabilities are discussed with specific regard for the circuit impedance, operating bias-voltage material characteristics, and the device temperature. The active impedance of a stable device has been measured, along with the effects of the package parasitic. These data were utilized to design multiple-tuned wide-band circulator-coupled coaxial-amplifier networks. Instantaneous CW bandwidths of nearly 1 octave have been measured in C-band, and instantaneous bandwidths of 4 GHz have been measured in X-band with single-stage linear gains from 6 to 12 dB. A -1-dB gain compression power output of 250 mW, with a saturated power output approaching 1 watt, has been realized from a single device. The noise figure of a single-stage amplifier has been found to be 15 dB. The phase response of a typical amplifier has been found to be linear with a differential phase shift of less than 20° /GHz. The amplitude linearity has been related to third-order intermodulation distortion and found to be comparable to that obtainable from traveling-wave-tube amplifiers (TWTAs). In a two-stage configuration a small-signal gain of 22 dB and a fractional bandwidth of 35 percent have been realized in C-band. A novel scheme for studying the gain response of pulse-biased devices using swept-frequency techniques has been developed. Pulsed amplification has been obtained with a power output of 2 watts at a 5-percent duty cycle with a conversion efficiency of 6 percent and a bandwidth of 1 GHz.

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Large-Signal Operation of Avalanche-Diode Amplifiers

E.F. Scherer. "Large-Signal Operation of Avalanche-Diode Amplifiers." 1970 Transactions on Microwave Theory and Techniques 18.11 (Nov. 1970 [T-MTT] (Special Issue on Microwave Circuit Aspects of Avalanche-Diode and Transferred Electron Devices)): 922-932.

The effects of large signals on the performance of avalanche amplifiers under various operating and circuit conditions are investigated. Numerical results from a large-signal computer program based on an approximate nonlinear analysis are compared with experiment. It is found that the resulting distortions in the gain response are particularly pronounced in multiple-tuned amplifier circuits. Transfer characteristics of avalanche amplifiers are examined and intermodulation measurements compared with those of TWTs. Preliminary data indicate that avalanche amplifiers compare favorably with TWTs in their distortion characteristics.

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Gain-Bandwidth Optimization of Avalanche-Diode Amplifiers

W.H. Ku and E.F. Scherer. "Gain-Bandwidth Optimization of Avalanche-Diode Amplifiers." 1970 Transactions on Microwave Theory and Techniques 18.11 (Nov. 1970 [T-MTT] (Special Issue on Microwave Circuit Aspects of Avalanche-Diode and Transferred Electron Devices)): 932-942.

This paper contains both theoretical and experimental results on the gain-bandwidth optimization of avalanche-diode amplifiers. These comprise a class of reflection-type negative-resistance amplifiers using avalanche diodes operating in the IMPATT or normal avalanche mode. Theoretical results on gain-bandwidth optimization are derived using various equivalent-circuit models for the IMPATT diode. These results form the basis for a design theory for broad-band avalanche-diode amplifiers. The basic model of the IMPATT diode is that of a band-limited negative-resistance device. Explicit gain-bandwidth limitations are presented in this paper for classes of modified Butterworth- and Chebyshev-amplifier responses. This is then followed by a description of experimental results on broad-band avalanche-diode amplifiers.

Abstracts

IMPATT-Diode Multistage Transmission Amplifiers

H.C. Bowers, T.A. Midford and S.T. Plants. "IMPATT-Diode Multistage Transmission Amplifiers." 1970 Transactions on Microwave Theory and Techniques 18.11 (Nov. 1970 [T-MTT] (Special Issue on Microwave Circuit Aspects of Avalanche-Diode and Transferred Electron Devices)): 943-951.

In this paper are described the analytical design and experimental performance of broad-band IMPATT-diode transmission amplifiers. These amplifiers are negative-resistance loaded waveguide bandpass filters which do not employ interstage isolation. Computer-aided-design techniques for single- and multiple-stage amplifiers are described in detail along with performance of simplifiers based on these designs. Typical performance at X-band includes large-signal gains of 5-10 dB, output power of 1 watt or greater, and bandwidths of up to 10 percent. These characteristics are in good agreement with the design values.

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Optimum Efficiency of a Cascade of Low-Gain Amplifiers

D.H. Steinbrecher. "Optimum Efficiency of a Cascade of Low-Gain Amplifiers." 1970 Transactions on Microwave Theory and Techniques 18.11 (Nov. 1970 [T-MTT] (Special Issue on Microwave Circuit Aspects of Avalanche-Diode and Transferred Electron Devices)): 951-956.

A low-gain amplifier dc-to-RF conversion efficiency analysis is presented. Three power-amplifier-efficiency definitions are compared, and it is shown that the generation efficiency is a useful quality factor for low-gain power amplifiers only if it can be assumed to be constant over a wide operating range. In the most frequently occurring case the generation efficiency is a function of drive and the dc operating point, and no single number provides enough information to characterize amplifier-efficiency performance. A graphical technique is presented for selecting the most efficient operating point for an amplifier with variable gain and generation efficiency.

Abstracts

Power Amplification with Anomalous Avalanche Diodes

H.J. Prager, K.K.N. Chang and S. Weisbrod. "Power Amplification with Anomalous Avalanche Diodes." 1970 Transactions on Microwave Theory and Techniques 18.11 (Nov. 1970 [T-MTT] (Special Issue on Microwave Circuit Aspects of Avalanche-Diode and Transferred Electron Devices)): 956-963.

The experiment described in this paper is performed for the purpose of obtaining additional information that might help to elucidate the operating principle of the anomalous mode. The diodes under investigation are of a silicon p/sup +/-n-n/sup +/ mesa structure. The breakdown voltage is 160 volts; the punch-through voltage is 60 volts. The test setup is similar to a conventional reflection-type amplifier with the diode mounted in a coaxial-cavity-like circuit. The reverse-bias pulse drives the diode to a low avalanche current level at which anomalous operation would normally commence. In this case, however, the tuning and loading of the cavity and its associated stubs is intentionally arranged to minimize free-running oscillations. Any residual RF power is reduced to the level of weak instabilities without any strong harmonics or subharmonic. Only in the presence of an input driving power with a frequency at or near the resonance frequency of the system, does an amplified power of the same frequency appear at the output port. Starting from the residual level the output power increases proportionally with the input power until at higher drives a saturation level is reached. In this particular case, operating at 410 MHz, saturation is reached at 18.5 watts with a maximum power gain of 12 dB and a bandwidth of 26 MHz. This output is approximately 20 to 30 dB higher in amplitude than any observable peak in the residual broad-band frequency spectrum Operating the diode as a free-running "hard" oscillator at the same current level and frequency, 18.8 Watts of RF power is obtained. The initial and steady-state power levels are substantially the same for both amplifier and oscillator. A plausible evaluation of these results can be obtained following van der Pol's differential equation for a forced negative-resistance oscillator.

Abstracts

A One-Watt CW High-Efficiency X-Band Avalanche-Diode Amplifier (Correspondence)

D.M. Snider. "A One-Watt CW High-Efficiency X-Band Avalanche-Diode Amplifier (Correspondence)." 1970 Transactions on Microwave Theory and Techniques 18.11 (Nov. 1970 [T-MTT] (Special Issue on Microwave Circuit Aspects of Avalanche-Diode and Transferred Electron Devices)): 963-967.

An X-band avalanche-diode amplifier circuit is described which provides accurate and independent in-band impedance control (R and +jx) and orthogonal second-harmonic reactance control. Low-level gains of 13 dB with 500 MHz of bandwidth have been achieved using this circuit. Power outputs of 1 watt CW with 5 dB of gain and 14.7-percent generation efficiency have also been realized by carefully controlling the in-band and second-harmonic load impedance.

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An Analysis of Rucker's Multidevice Symmetrical Oscillator (Correspondence)

K. Kurokawa. "An Analysis of Rucker's Multidevice Symmetrical Oscillator (Correspondence)." 1970 Transactions on Microwave Theory and Techniques 18.11 (Nov. 1970 [T-MTT] (Special Issue on Microwave Circuit Aspects of Avalanche-Diode and Transferred Electron Devices)): 967-969.

The oscillator circuit proposed by Rucker to combine the output powers from several devices is analyzed. Because of the symmetrical structure of his oscillator, an eigenvector approach is employed with special care to overcome difficulties due to the inherent nonlinearity of the devices. It is shown that under appropriate conditions Rucker's circuit offers very stable operation. His experimental results are successfully interpreted in terms of our analysis.

Abstracts

An Oscillator Circuit with Cap Structures for Millimeter-Wave IMPATT Diodes (Correspondence)

T. Misawa and N.D. Kenyon. "An Oscillator Circuit with Cap Structures for Millimeter-Wave IMPATT Diodes (Correspondence)." 1970 Transactions on Microwave Theory and Techniques 18.11 (Nov. 1970 [T-MTT] (Special Issue on Microwave Circuit Aspects of Avalanche-Diode and Transferred Electron Devices)): 969-970.

An oscillator circuit that has been particuiarly useful for testing millimeter-wave IMPATT diodes is described. Results of impedance measurements performed on a scale model are presented.

Abstracts

Frequency-Versus-Temperature Stabilization in Avalanche Transit-Time Oscillators by Use of Diode Parasitic Elements (Correspondence)

B.E. Sigmon. "Frequency-Versus-Temperature Stabilization in Avalanche Transit-Time Oscillators by Use of Diode Parasitic Elements (Correspondence)." 1970 Transactions on Microwave Theory and Techniques 18.11 (Nov. 1970 [T-MTT] (Special Issue on Microwave Circuit Aspects of Avalanche-Diode and Transferred Electron Devices)): 971-973.

Analyses of the packaged-diode-series resonant and antiresonant conditions of oscillation show that the antiresonant condition exhibits frequency versus temperature stability which is greatly improved as compared with that of the resonant condition. Frequency variation with temperature in coaxial-cavity avalanche transit-time oscillators is predominantly due to diode junction capacitance and cavity-length changes with temperature. By operation of the oscillator in the antiresonant condition, the effects of both the diode junction capacitance and the cavity-length changes with temperature are greatly reduced as compared with those observed in the resonant condition of oscillation. (The circuit will oscillate for line lengths intermediate to resonance and antiresonance; however, the temperature coefficient will depend on the extent to which the element C/sub a/ is shunted by the line.)

Abstracts

A Step-Iris Resonator for LSA Operation (Correspondence)

R.R. Spiwak. "A Step-Iris Resonator for LSA Operation (Correspondence)." 1970 Transactions on Microwave Theory and Techniques 18.11 (Nov. 1970 [T-MTT] (Special Issue on Microwave Circuit Aspects of Avalanche-Diode and Transferred Electron Devices)): 973-975.

A step-iris resonator circuit which substantially increases the efficiency of limited-space-charge-accumulation (LSA) oscillators has been designed. The circuit design employs harmonic tuning that provides the proper impedances at the second and third harmonics of the oscillator frequency. The efficiency obtained with the step-iris resonator is about 1.7 times greater than that obtained with a conventional rectangular resonant iris.

Abstracts

Computer Simulation of Anomalous-Mode Oscillation in Silicon Avalanche Diodes (Correspondence)

M. Matsumura and H. Abe. "Computer Simulation of Anomalous-Mode Oscillation in Silicon Avalanche Diodes (Correspondence)." 1970 Transactions on Microwave Theory and Techniques 18.11 (Nov. 1970 [T-MTT] (Special Issue on Microwave Circuit Aspects of Avalanche-Diode and Transferred Electron Devices)): 975-977.

Computer simulations of the free-running oscillation of an avalanche diode inserted at one end of a multifrequency coaxial-line resonator are presented. The obtained transient behaviors indicate that for triggering of the anomalous-mode oscillation, a large-signal IMPATT-mode oscillation is not always necessary. The waveform of the anomalous mode under steady-state conditions can be constructed by the superposition of a sawtooth and a positive spike waveform.

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Abstracts

An Analytic Theory for the Evans Circuit for Avalanche Diodes (Correspondence)

J.E. Carroll. "An Analytic Theory for the Evans Circuit for Avalanche Diodes (Correspondence)." 1970 Transactions on Microwave Theory and Techniques 18.11 (Nov. 1970 [T-MTT] (Special Issue on Microwave Circuit Aspects of Avalanche-Diode and Transferred Electron Devices)): 977-979.

An analytic theory is outlined for the operation of avalanche diodes in the circuit first analyzed by Evens. This consists of a low-pass filter situated approximately one-half wavelength from the diode. The magnitude and rate of rise of the voltage for a given charge pulse are estimated, and expressions for the efficiency and diode impedance are developed. It is shown for this model, where the filter acts as a short circuit at all frequencies other than the fundamental, how efficiencies around 30-40 percent can be achieved. The theory is compared with Evans' experimental results and shows fair agreement.

Abstracts

Silicon Avalanche-Diode Microstrip L-Band Oscillator (Correspondence)

A. Rosen and J. Assour. "Silicon Avalanche-Diode Microstrip L-Band Oscillator (Correspondence)." 1970 Transactions on Microwave Theory and Techniques 18.11 (Nov. 1970 [T-MTT] (Special Issue on Microwave Circuit Aspects of Avalanche-Diode and Transferred Electron Devices)): 979-981.

A metal ceramic microstrip oscillator circuit using high-efficiency silicon avalanche diodes mounted in capacitively loaded transverse-electromagnetic (TEM) coupled lines is described. The physical dimensions of the oscillator circuit are 1.5 by 1.0 by 0.5 inches high. Results achieved at L-band are 105 watts peak output at 1.5 GHz with 13-percent efficiency.

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A Compact Microstrip High-Power High-Efficiency Avalanche-Diode Oscillator (Correspondence)

S.-G. Liu. "A Compact Microstrip High-Power High-Efficiency Avalanche-Diode Oscillator (Correspondence)." 1970 Transactions on Microwave Theory and Techniques 18.11 (Nov. 1970 [T-MTT] (Special Issue on Microwave Circuit Aspects of Avalanche-Diode and Transferred Electron Devices)): 982-983.

This paper describes a simple compact L-band microstrip oscillator circuit using avalanche diodes operating in the high-efficiency mode. The circuit has produced 150 watts with 26-percent efficiency; the duty cycle is 1 percent at the 100-watt power level. The overall size of the circuit is reducible to 1 by 2 inches using metal-on-alumina microstrip. Frequency tuning between 1.62 GHz and 1.83 GHz with less than 1.2-dB variation in power output has been demonstrated.

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Abstracts

A Proposed Circuit Model for Microstripline TRAPATT Oscillators (Correspondence)

R.J. Chaffin. "A Proposed Circuit Model for Microstripline TRAPATT Oscillators (Correspondence)." 1970 Transactions on Microwave Theory and Techniques 18.11 (Nov. 1970 [T-MTT] (Special Issue on Microwave Circuit Aspects of Avalanche-Diode and Transferred Electron Devices)): 983-985.

Described in this paper is a simple microstripline circuit suitable for supporting TRAPATT oscillations with the Fairchild FD-300 diode. The best result obtained was a pulsed output of 42 watts at 520 MHz with an efficiency of 9 percent. Also presented is a circuit model for predicting the frequency of operation. The resulting theory is shown to be in good agreement with the observed experimental data and provides a useful tool for designing low-frequency TRAPATT oscillators with small dimensions.

Abstracts

High-Power TRAPATT Oscillations from Parallel-Connected Low-Cost Diodes (Correspondence)

R.J. Chaffin. "High-Power TRAPATT Oscillations from Parallel-Connected Low-Cost Diodes (Correspondence)." 1970 Transactions on Microwave Theory and Techniques 18.11 (Nov. 1970 [T-MTT] (Special Issue on Microwave Circuit Aspects of Avalanche-Diode and Transferred Electron Devices)): 985-986.

This paper reports successful parallel TRAPATT operation of a very low-cost commercial diode type. The best result achieved was a pulsed output of 225 watts at 700 MHz with an efficiency of 33 percent. The result was achieved by using three diodes in parallel. An explanation of the success of parallel operation is given. It is also shown that precise control of breakdown voltage is not necessarily required for parallel TRAPATT operation.

Abstracts

CW TRAPATT Amplification (Correspondence)

W.J. Evans. "CW TRAPATT Amplification (Correspondence)." 1970 Transactions on Microwave Theory and Techniques 18.11 (Nov. 1970 [T-MTT] (Special Issue on Microwave Circuit Aspects of Avalanche-Diode and Transferred Electron Devices)): 986-988.

High-efficiency CW amplification has been obtained using germanium TRAPATT diodes. Several modes of amplification are described. The first mode gives approximately a 12-dB gain with a maximum efficiency of 25 percent at saturation. The second mode exhibits lower gain, but at a relatively low input power the diode switches into a locked TRAPATT oscillator mode with an efficiency of approximately 35 percent. Each of these modes exhibits a noise figure of approximately 120 dB. A third mode which allows the diode to oscillate in the TRAPATT mode at one frequency and to amplify at a second frequency has also been obtained. The noise figure for this mode is approximately 60 dB.

Abstracts

Frequency-Modulation Noise of Subharmonically Injection Phase-Locked IMPATT Oscillator (Correspondence)

R. Perichon. "Frequency-Modulation Noise of Subharmonically Injection Phase-Locked IMPATT Oscillator (Correspondence)." 1970 Transactions on Microwave Theory and Techniques 18.11 (Nov. 1970 [T-MTT] (Special Issue on Microwave Circuit Aspects of Avalanche-Diode and Transferred Electron Devices)): 988-989.

Measured FM noise spectra of subharmonically phase-locked avalanche transit-time oscillators are presented. An improvement of the frequency-modulation noise is achieved.

Abstracts

On Injection-Locking Figure of Merit for Avalanche, Gunn, and Other Oscillators (Correspondence)

D.D. Khandelwal. "On Injection-Locking Figure of Merit for Avalanche, Gunn, and Other Oscillators (Correspondence)." 1970 Transactions on Microwave Theory and Techniques 18.11 (Nov. 1970 [T-MTT] (Special Issue on Microwave Circuit Aspects of Avalanche-Diode and Transferred Electron Devices)): 989-992.

Injection-locking figure of merit has been derived for a negative-resistance oscillator in terms of the frequency compliance coefficient. A method of estimating this under small-injected-signal conditions for any device operating in any mode and a given circuit is described. The method requires the knowledge of the device impedance evaluated either from a large-signal analysis or experimentally and a proper description of the microwave circuit. A practical case of a Gunn-effect device operating in the quenched-domain mode has been described for illustration.

Abstracts

Peak AC Voltage Limitations in Second-Harmonically Tuned IMPATT Diodes (Correspondence)

C.A. Brackett. "Peak AC Voltage Limitations in Second-Harmonically Tuned IMPATT Diodes (Correspondence)." 1970 Transactions on Microwave Theory and Techniques 18.11 (Nov. 1970 [T-MTT] (Special Issue on Microwave Circuit Aspects of Avalanche-Diode and Transferred Electron Devices)): 992-993.

The tuned-harmonic mode of IMPATT-diode oscillation is examined under the restriction of a maximum limit to the peak-to-peak voltage swing. It is concluded that if a peak ac voltage limitation is effective in limiting the output power of an IMPATT diode, the maximum output power is achieved under conditions which minimize the harmonic interaction and at an operating frequency equal to the transit-time frequency.

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Abstracts

Admittance Measurement of IMPATT Diode at X-band (Correspondence)

T. Isobe and T. Nakamura. "Admittance Measurement of IMPATT Diode at X-band (Correspondence)." 1970 Transactions on Microwave Theory and Techniques 18.11 (Nov. 1970 [T-MTT] (Special Issue on Microwave Circuit Aspects of Avalanche-Diode and Transferred Electron Devices)): 993-995.

Investigation has been made on the small- and large-signal admittances of a Si IMPATT diode in the frequency range of 8-12 GHz over high current densities. In order to separate the diodewafer elements from the parasitic elements of the package, the bias-sweeping method proposed by Gewartowski and Morris is employed. Representative plots are given for wafer conductance and susceptance as functions of frequency with current density as a parameter. In addition, the variation of the large-signal admittance with a function of RF voltage is presented. The data obtained are compared with analytical small-signal theory.

Abstracts

A New Technique for the Characterization of Microwave Avalanche Diodes (Correspondence)

P.W. Shackle. "A New Technique for the Characterization of Microwave Avalanche Diodes (Correspondence)." 1970 Transactions on Microwave Theory and Techniques 18.11 (Nov. 1970 [T-MTT] (Special Issue on Microwave Circuit Aspects of Avalanche-Diode and Transferred Electron Devices)): 995-998.

Sample theoretical arguments are used to show that at low current densities the negative-resistance properties of a packaged avalanche diode may be represented by only three parameters. These three parameters may be easily measured with the diode in a nonoscillating state. Once these parameters have been measured for a diode, its oscillator performance can be predicted for any well-defined circuit with an accuracy of about 10 percent. An example characterization of a diode is described, and the predicted and experiments performances of this diode when used in an oscillator circuit are then compared.

Abstracts

Measurement of Interaction Impedance of Microwave Circuits for Solid-State Devices (Correspondence)

S.P. Yu and J.D. Young. "Measurement of Interaction Impedance of Microwave Circuits for Solid-State Devices (Correspondence)." 1970 Transactions on Microwave Theory and Techniques 18.11 (Nov. 1970 [T-MTT] (Special Issue on Microwave Circuit Aspects of Avalanche-Diode and Transferred Electron Devices)): 999-1001.

The performance of a microwave solid-state device not only depends upon its intrinsic characteristics but also to a large extent on the circuit interaction impedance seen by the mobile carriers in the device. In this paper the well-known perturbation technique for measuring the interaction impedance of linear accelerators and microwave tubes is adapted for measuring the interaction impedance of circuits for solid-state microwave sources. Experimental results indicate that the technique can provide a powerful method for circuit optimization and device characterization.

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Improvement of a Microwave Discriminator by an Injection Phase-Locked Oscillator (Correspondence)

J.R. Ashley and F.M. Palka. "Improvement of a Microwave Discriminator by an Injection Phase-Locked Oscillator (Correspondence)." 1970 Transactions on Microwave Theory and Techniques 18.11 (Nov. 1970 [T-MTT] (Special Issue on Microwave Circuit Aspects of Avalanche-Diode and Transferred Electron Devices)): 1001-1002.

An injection phase-locked oscillator is used as an input microwave-limiting amplifier for a microwave discriminator (FM demodulator) used for noise measurement. This amplifier simultaneously increases sensitivity by 6 dB and reduces the threshold (minimum measurable FM) by at least 10 dB. The oscillator can be frequency-modulated to calibrate the measurement.

Abstracts

A Modulation Method for the Measurement of Microwave Oscillator Q (Correspondence)

J.R. Ashley and F.M. Palka. "A Modulation Method for the Measurement of Microwave Oscillator Q (Correspondence)." 1970 Transactions on Microwave Theory and Techniques 18.11 (Nov. 1970 [T-MTT] (Special Issue on Microwave Circuit Aspects of Avalanche-Diode and Transferred Electron Devices)): 1002-1004.

A simple modulation technique based on injection phase-locking theory is given for measuring microwave oscillator Q. The measurement procedure is described and typical data are presented for an avalanche-diode oscillator.

Abstracts

High-Power Gunn Oscillator Diodes on Type-IIa Diamond Heat Sinks (Correspondence)

M. Migitaka, M. Miyazaki and K. Saito. "High-Power Gunn Oscillator Diodes on Type-IIa Diamond Heat Sinks (Correspondence)." 1970 Transactions on Microwave Theory and Techniques 18.11 (Nov. 1970 [T-MTT] (Special Issue on Microwave Circuit Aspects of Avalanche-Diode and Transferred Electron Devices)): 1004-1005.

Gallium arsenide Gunn diodes were mounted on a type-IIa diamond to reduce the thermal spreading resistance just under the wafer of the diodes. By using the diamond, the total thermal resistance of the diodes was reduced to half the usual resistance. A single-wafer Gunn diode on the type-IIa diamond produced 910 mW at 9.9 GHz with an efficiency of 3.1 percent.

Abstracts

Exact Design of TEM Microwave Networks Using Quarter-Wave Lines (Correction)

R.J. Wenzel. "Exact Design of TEM Microwave Networks Using Quarter-Wave Lines (Correction)." 1970 Transactions on Microwave Theory and Techniques 18.11 (Nov. 1970 [T-MTT] (Special Issue on Microwave Circuit Aspects of Avalanche-Diode and Transferred Electron Devices)): 1005-1006.

In the above paper, Section IV-B, p. 103, an error occurs in the comparison between lumped and distributed bandpass-filter networks.

Abstracts

Hybrid T Synthesis (Computer Program Descriptions)

R.B. Ekinge. "Hybrid T Synthesis (Computer Program Descriptions)." 1970 Transactions on Microwave Theory and Techniques 18.11 (Nov. 1970 [T-MTT] (Special Issue on Microwave Circuit Aspects of Avalanche-Diode and Transferred Electron Devices)): 1006-1007.

The program executes the computational steps in a synthesis procedure for matched equiphase power dividers. The three-ports consist of n sections in cascade, with each section composed of two coupled lossless transmission lines of electrical length theta and an intermediate resistor.

Abstracts

Contributors (Nov. 1970 [T-MTT])

B.E. Berson, B.G. Bosch, H.C. Bowers, D. Cawsey, K.K.N. Chang, D.R. Conn, D.R. Decker, C.N. Dunn, R.W.H. Engelmann, R.E. Enstrom, W.J. Evans, R.L. Frank, S.J. Fray, W. Frey, S.E. Gibbs, P.T. Greiling, G.I. Haddad, T. Isobe, Y. Ito, P.J. Khan, H. Komizo, H. Kondo, W.H. Ku, L.A. MacKenzie, R.E. Marx, T.A. Midford, H.R. Mitchell, K. Mouthaan, S. Nagano, S.Y. Narayan, T.L. Osborne, R.P. Owens, I.W. Pence, Jr., B.S. Perlman, S.T. Plants, H. Pollmann, H.J. Prager, J.F. Reynolds, F.J. Rosenbaum, S. Sasagawa, E.F. Scherer, W.E. Schroeder, D.H. Steinbrecher, F. Sterzer, J.A.C. Stewart, B.C. Taylor, M. Tokida, W.C. Tsai, C.L. Upadhyayula and S. Weisbrod. "Contributors (Nov. 1970 [T-MTT])." 1970 Transactions on Microwave Theory and Techniques 18.11 (Nov. 1970 [T-MTT] (Special Issue on Microwave Circuit Aspects of Avalanche-Diode and Transferred Electron Devices)): 1008-1015.

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Information on Computer Program Descriptions (Nov. 1970 [T-MTT])

"Information on Computer Program Descriptions (Nov. 1970 [T-MTT])." 1970 Transactions on Microwave Theory and Techniques 18.11 (Nov. 1970 [T-MTT] (Special Issue on Microwave Circuit Aspects of Avalanche-Diode and Transferred Electron Devices)): 1016-1016.

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Back Cover (Nov. 1970 [T-MTT])

"Back Cover (Nov. 1970 [T-MTT])." 1970 Transactions on Microwave Theory and Techniques 18.11 (Nov. 1970 [T-MTT] (Special Issue on Microwave Circuit Aspects of Avalanche-Diode and Transferred Electron Devices)): b1-b2.

Abstracts

Front Cover (Dec. 1970 [T-MTT])

"Front Cover (Dec. 1970 [T-MTT])." 1970 Transactions on Microwave Theory and Techniques 18.12 (Dec. 1970 [T-MTT] (1970 Symposium Issue)): f1-f2.

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"Table of Contents (Dec. 1970 [T-MTT])." 1970 Transactions on Microwave Theory and Techniques 18.12 (Dec. 1970 [T-MTT] (1970 Symposium Issue)): 1017-1017.

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International Microwave Symposium (Dec. 1970 [T-MTT])

S. Sensiper. "International Microwave Symposium (Dec. 1970 [T-MTT])." 1970 Transactions on Microwave Theory and Techniques 18.12 (Dec. 1970 [T-MTT] (1970 Symposium Issue)): 1018-1020.

Despite shrinking programs and economic difficulties in the microwave field, the 1970 IEEE G-MTT International Symposium was well attended with a total of over 580 registrants. The Newporter Inn, Newport Beach, Calif., provided an ideal location for the Symposium; this setting was enhanced even further by the pleasant weather. If the four-day schedule with many multiple sessions seemed overly long to some, it had the advantage of permitting a wide range of papers and subjects to be presented. The listed technical program was supplemented by several late news items that were added to appropriate sessions.

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G-MTT National Lectureship (Dec. 1970 [T-MTT])

H. Sobol. "G-MTT National Lectureship (Dec. 1970 [T-MTT])." 1970 Transactions on Microwave Theory and Techniques 18.12 (Dec. 1970 [T-MTT] (1970 Symposium Issue)): 1020-1021.

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Abstracts

Analysis of the Arbitrarily Shaped Waveguide by Polynomial Approximation

R.M. Bulley. "Analysis of the Arbitrarily Shaped Waveguide by Polynomial Approximation." 1970 Transactions on Microwave Theory and Techniques 18.12 (Dec. 1970 [T-MTT] (1970 Symposium Issue)): 1022-1028.

Theory is described for a computer program EHPOL which produces polynomial approximations to eigenfunctions of the Helmholtz equation in the interior of an arbitrarily shaped plane region. TWO types of boundary conditions are considered: homogeneous Neumann and Dirichlet. Neumann boundaries pose much fewer difficulties than do Dirichlet so considerable attention has been given to the construction of polynomial subspaces that satisfy the Dirichlet constraint. EHPOL evaluates the modes by the Rayleigh-Ritz method and employs efficient algorithms both for the setting up of the matrix eigenproblem and for its solution. For convex guides the program is fast, economical in store space, and produces solutions of remarkable accuracy. An analysis of the computing time for EHPOL is given. Eigenvalue accuracy is demonstrated by tables of exact and computed eigenvalues for E- and H-modes in circular waveguide. Full advantage may be taken of regions with symmetry axes. A FORTRAN listing and a description of the program is available.

Abstracts

Interdigital Capacitors and Their Application to Lumped-Element Microwave Integrated Circuits

G.D. Alley. "Interdigital Capacitors and Their Application to Lumped-Element Microwave Integrated Circuits." 1970 Transactions on Microwave Theory and Techniques 18.12 (Dec. 1970 [T-MTT] (1970 Symposium Issue)): 1028-1033.

An analysis of the frequency response of interdigital capacitors, which leads to an optimal design, is given along with an expression for their static gap capacitance. The capacitor Q is given in terms of its geometry which consists of a planar interdigital thin-film conductor deposited on the surface of a relatively high dielectric constant substrate. Capacitance values ranging from 0.1 to 10 pF at L band with measured Q's in excess of 400 are realizable using 2-mil line and space widths on a 99.5-percent alumina substrate with a dielectric constant of 10.3. Experimental results obtained with a lumped-constant nine-section S-band Chebyscheff low-pass filter realized using spiral inductors and optimal designed interdigital capacitors are shown to be in excellent agreement with theory. The filter had less than 0.8-dB insertion loss and greater than 25dB return loss in the passband. The filter occupies an area 6.50 by 200 roils on a 24-mil-thick substrate.

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Abstracts

Launching Efficiency of the HE/sub 11/ Surface Wave Mode on a Dielectric Rod

G.L. Yip. "Launching Efficiency of the HE/sub 11/ Surface Wave Mode on a Dielectric Rod." 1970 Transactions on Microwave Theory and Techniques 18.12 (Dec. 1970 [T-MTT] (1970 Symposium Issue)): 1033-1041.

The excitation of the dominant HE/sub 11/ mode by a transversely oriented electric dipole on the axis of an infinitely long dielectric rod is studied. The method of analysis involves expressing the fields and the source in a Fourier integral in the z direction and a Fourier series in the phi direction in a cylindrical coordinate system (rho, phi, z). The practical significance of the present study, in particular regard to the excitation problem in dielectric surface waveguides, is emphasized.

Abstracts

On the Restricted Validity of Point-Matching Techniques (Dec. 1970 [T-MTT])

L. Lewin. "On the Restricted Validity of Point-Matching Techniques (Dec. 1970 [T-MTT])." 1970 Transactions on Microwave Theory and Techniques 18.12 (Dec. 1970 [T-MTT] (1970 Symposium Issue)): 1041-1047.

The usefulness of point matching when the expansion representing the field diverges in the matching region is discussed in relation to previous work. It is shown that the presence of a metal boundary does not necessarily imply divergence of series representations at the boundary position. The Rayleigh hypothesis, which bears on this, and the extended-boundary-condition method are equivalent only in a restricted sense; the latter is hypersensitive to minute deviations of the field on the reduced boundary and is therefore unsuited to point matching for some shapes. A numerical example is examined in which the use of a divergent series gives little evidence of error from use in the divergent region. Attention is drawn to recent work in which the use of a sutliciently smooth spectral expansion is shown to be able to convert a series of divergent terms into a usable convergent series, permitting valid numerical computations with otherwise divergent representations.

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Abstracts

A Short-Slot Waveguide Latching Ferrite Switch (Dec. 1970 [T-MTT])

S. Nakahara and H. Kurebayashi. "A Short-Slot Waveguide Latching Ferrite Switch (Dec. 1970 [T-MTT])." 1970 Transactions on Microwave Theory and Techniques 18.12 (Dec. 1970 [T-MTT] (1970 Symposium Issue)): 1048-1051.

A new type of latching switch, which consists of a short-slot waveguide junction loaded with a latched ferrite at the coupling section, is presented. The behavior of this switch is explained by application of the concept of a short-slot waveguide directional coupler. In order to estimate isolation characteristics, the phase constants of the two modes in the coupling section loaded with ferrite toroid are calculated. Practical construction based upon the calculated results has been carried out, and a switch with 8-percent bandwidth has been obtained.

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Generalized Rational Function Approximation in Finite Intervals Using Zolotarev Functions

R. Levy. "Generalized Rational Function Approximation in Finite Intervals Using Zolotarev Functions." 1970 Transactions on Microwave Theory and Techniques 18.12 (Dec. 1970 [T-MTT] (1970 Symposium Issue)): 1052-1064.

The results of Chebyshev in the theory of approximation find wide application in the design of circuits and microwave components. Part of the comparatively unknown work of Zolotarev and Achieser which has found useful applications in the design of certain microwave components, especially of mixed lumped/distributed components, is described. Several new results are presented, including formulas which enable the approximation functions to be computed in a relatively simple manner.

Abstracts

A New Class of Distributed Prototype Filters with Applications to Mixed Lumped/Distributed Component Design

R. Levy. "A New Class of Distributed Prototype Filters with Applications to Mixed Lumped/Distributed Component Design." 1970 Transactions on Microwave Theory and Techniques 18.12 (Dec. 1970 [T-MTT] (1970 Symposium Issue)): 1064-1071.

The distributed prototype filter consists of a cascade of shunt stubs of equal length alternating with uniform transmission lines, each of twice the stub length. If the stubs are open circuited, they may be replaced by lumped capacitors to synthesize a mixed lumped/distributed (L/D) filter having near optimum Chebyshev or Zolotarev characteristics. The rate of cutoff and the general character of the stopband region is predictable. The use of Zolotarev prototypes enables the impedance level within the filter to be controlled and gives greater selectivity. Designs suitable for either transverse electromagnetic (TEM) line or waveguide low-pass filters are presented. If the stubs are short-circuited, the prototype may be used to design quasi-high-pass or bandpass filters of very large bandwidth. An example is given of an inductive-iris-type filter of approximately 100-percent bandwidth for which previous theories have been unsuitable. The theory is capable of extension to more complicated mixed L/D structures containing both series and shunt elements.

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A Dual-Channel Rotary Joint for High Average Power Operation (Dec. 1970 [T-MTT])

O.M. Woodward. "A Dual-Channel Rotary Joint for High Average Power Operation (Dec. 1970 [T-MTT])." 1970 Transactions on Microwave Theory and Techniques 18.12 (Dec. 1970 [T-MTT] (1970 Symposium Issue)): 1072-1077.

A new type of dual-channel rotary joint combining the TM/sub 01/ mode and the circularly polarixed TE/sub 11/ modes in circular waveguide has been developed for an X-band antenna employed in a satellite communications link. Low losses are obtained in the high average power transmit channel (12.5 kW, CW) to avoid excessive temperature rise and in the receive channel to reduce the noise temperature of the system. High isolation between channels is achieved with the compact multimode exciters.

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Beam Lead Tunnel Diode Amplifiers on Microstrip (Dec. 1970 [T-MTT])

J.D. Welch. "Beam Lead Tunnel Diode Amplifiers on Microstrip (Dec. 1970 [T-MTT])." 1970 Transactions on Microwave Theory and Techniques 18.12 (Dec. 1970 [T-MTT] (1970 Symposium Issue)): 1077-1083.

The characteristics of beam lead tunnel diodes and their application in low-cost microstrip reflection amplifiers are discussed. Three low-noise C-band amplifiers are described, including one with the amplifier printed directly on a garnet substrate with a three-port Y-junction circulator.

Abstracts

Study of Insertion-Phase Variation in a Class of Ferrite Phasers

C.R. Boyd, Jr., L.R. Whicker and R.W. Jansen. "Study of Insertion-Phase Variation in a Class of Ferrite Phasers." 1970 Transactions on Microwave Theory and Techniques 18.12 (Dec. 1970 [T-MTT] (1970 Symposium Issue)): 1084-1089.

Insertion-phase variations for dual-mode reciprocal ferrite phasers are investigated in this paper. Expressions for variation in insertion phase as a function of ambient temperature are derived, as well as equations predicting insertion-phase changes resulting from high-average-power heating effects. Experimental data for an S-band phaser designed to operate at high-peak and high-average-power levels are presented. A total change in insertion phase of 6.4 degrees for 1000-watt average input power is computed and measured within experimental accuracy. The merits of this class of phaser for high-power application are considered.

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Abstracts

Slot-Line Filters and Couplers

E.A. Mariani and J.P. Agrios. "Slot-Line Filters and Couplers." 1970 Transactions on Microwave Theory and Techniques 18.12 (Dec. 1970 [T-MTT] (1970 Symposium Issue)): 1089-1095.

The slot-transmission line on a dielectric substrate has many possible microwave circuit applications. This paper presents experimental data concerning the performance of bandpass and bandstop filters and a hybrid coupler; the work described was performed at S-band frequencies using the single substrate slot line geometry. Also included are theoretical data concerning the slot-line wavelength and characteristic impedance for the case of the slot-line configuration having dielectric material above and below the metsllization, the so-called slot-line "sandwich."

Abstracts

The Compact Turnstile Circulator (Dec. 1970 [T-MTT])

B. Owen and C.E. Barnes. "The Compact Turnstile Circulator (Dec. 1970 [T-MTT])." 1970 Transactions on Microwave Theory and Techniques 18.12 (Dec. 1970 [T-MTT] (1970 Symposium Issue)): 1096-1100.

This paper discusses the mode of operation of certain partial height ferrite, Y-junction circulators. It is proposed that such devices operate in a turnstile fashion with modes propagating axially along the ferrite rod. A simple experiment on a 4-GHz circulator substantiates this proposal, and a millimeter-wave device operating in this manner is described.

Abstracts

A Compact Broad-Band Thin-Film Lumped-Element L-Band Circulator

R.H. Knerr, C.E. Barnes and F. Bosch. "A Compact Broad-Band Thin-Film Lumped-Element L-Band Circulator." 1970 Transactions on Microwave Theory and Techniques 18.12 (Dec. 1970 [T-MTT] (1970 Symposium Issue)): 1100-1108.

Impedance matrices including magnetic losses are developed for a number of lumped-element ferrite-loaded symmetrical three-port junctions. The scattering matrix eigenvalues corresponding to these matrices are determined as functions of frequency and circuit parameters and are used to analyze these three-ports with emphasis on their properties as circulators. A very compact broad-band thin-film lumped-element circulator is derived from the idealized equivalent circuit. An experimental model approximately represented by this circuit is shown to have a 20-dB isolation bandwidth of greater than 30 percent with an insertion loss of less than 0.6 decibel. A switchable circulator which requires no magnetic-field switching is treated using this same analytical approach. It is suggested that this type of analysis together with additional experimental refinement of equivalent circuits will lead eventually to a computerized design of lumped-element circulators.

Abstracts

A Four-Cavity Elliptic Waveguide Filter (Dec. 1970 [T-MTT])

A.E. Williams. "A Four-Cavity Elliptic Waveguide Filter (Dec. 1970 [T-MTT])." 1970 Transactions on Microwave Theory and Techniques 18.12 (Dec. 1970 [T-MTT] (1970 Symposium Issue)): 1109-1114.

Realization of the bandpass fourth-order antimetric elliptic filter function in a waveguide structure is described. A mathematical model is shown to accurately predict the performance of the experimental narrow-bandpass waveguide filter.

Abstracts

An 18-GHz Double-Tuned Parametric Amplifier (Dec. 1970 [T-MTT])

Y. Kinoshita and M. Maeda. "An 18-GHz Double-Tuned Parametric Amplifier (Dec. 1970 [T-MTT])." 1970 Transactions on Microwave Theory and Techniques 18.12 (Dec. 1970 [T-MTT] (1970 Symposium Issue)): 1114-1119.

A K/sub u/-band nondegenerate parametric amplifier using a single-packaged GaAs varactor diode is described. A very simple structure of the single-tuned amplifier with a new type of idler choke is employed to obtain a large voltage-gain bandwidth product and a low noise temperature. The double-tuned operation exhibits a nearly flat bandwidth of 550 MHz at a 20-dB gain and a noise temperature of 280°K at room-temperature ambience.

Abstracts

A Dual-Mode Latching Reciprocal Ferrite Phase Shifter (Dec. 1970 [T-MTT])

C.R. Boyd, Jr.. "A Dual-Mode Latching Reciprocal Ferrite Phase Shifter (Dec. 1970 [T-MTT])." 1970 Transactions on Microwave Theory and Techniques 18.12 (Dec. 1970 [T-MTT] (1970 Symposium Issue)): 1119-1124.

A ferrite phase shifter has been developed to provide latching reciprocal phase shift over a moderate frequency band. The principle of operation is based on the use of dual-mode circularly polarized waves in the active ferrite with nonreciprocal polarizers to select modes that provide reciprocal transmission phase. The physical structure of the phase shifter consists of a metallized assembly of ferrite and ceramic dielectric. A ferrite yoke is fitted over a portion of this assembly to permit latching operation. The completed phase shifter has a very simple geometry that can be produced at low cost and has relatively low insertion loss. The maximum cross-sectional dimensions are small and are consequently compatible with application in two-dimensional electronically scanned arrays. Experimental results are presented for an X-band design having a 10-percent bandwidth centered near 9 GHz.

Abstracts

Numerical Solution of Dielectric Loaded Waveguides: I--Finite-Element Analysis

Z.J. Csendes and P. Silvester. "Numerical Solution of Dielectric Loaded Waveguides: I--Finite-Element Analysis." 1970 Transactions on Microwave Theory and Techniques 18.12 (Dec. 1970 [T-MTT] (1970 Symposium Issue)): 1124-1131.

A variational expression of the electromagnetic fields in dielectric loaded waveguides is derived. This expression is discretized using the finite-element method and an electromagnetic coupling matrix is derived and evaluated. No restriction is placed on the shapes of the triangular elements or the order of the polynomial approximation. A general finite-element computer program is described and dispersion curves and field plots of some dielectric loaded waveguides are presented.

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Abstracts

Unequal-Arm Finite-Difference Operators in the Positive-Definite Successive Over-relaxation (PDSOR) Algorithm

M.J. Beaubien and A. Wexler. "Unequal-Arm Finite-Difference Operators in the Positive-Definite Successive Over-relaxation (PDSOR) Algorithm." 1970 Transactions on Microwave Theory and Techniques 18.12 (Dec. 1970 [T-MTT] (1970 Symposium Issue)): 1132-1149.

In an earlier publication, a procedure was described that permitted the application of successive overrelaxation (SOR) to the solution of higher modes of any uniform waveguide of arbitrary cross section, filled with an isotropic and homogeneous medium. An algorithm was described that employed a thirteen-point finite-difference operator formed from five constituent five-point operators, such that the resulting matrix was positive semidefinite at the correct eigenvalue and was positive definite otherwise. For compactness the method is called positive definite successive overrelaxation (PDSOR). For simplicity boundary fitting was accomplished by causing horizontal waveguide deformations at each horizontal mesh line to the nearest node point. This paper describes an improvement of the PDSOR algorithm to cater for unequal-armed operators so that the waveguide wall need not be distorted from its actual shape. Improved accuracy is obtained for fields in the vicinity of the boundary and for eigenvalues. A finite-difference first-order perturbation method (that makes use of the accurately determined wall currents) for attenuation in arbitrarily shaped waveguides is described. Normalized curves are presented giving attenuation of sets of TE and TM modes in circular, lunar, T-septate lunar, single-ridge, and T-septate rectangular waveguides.

Abstracts

Small Elliptic-Function Low-Pass Filters and other Applications of Microwave C Sections

R.J. Wenzel. "Small Elliptic-Function Low-Pass Filters and other Applications of Microwave C Sections." 1970 Transactions on Microwave Theory and Techniques 18.12 (Dec. 1970 [T-MTT] (1970 Symposium Issue)): 1150-1158.

A type of elliptic-function low-pass filter that is easy to design and construct, has low passband loss, and is very compact is described. With simple scaling and a limited number of standard parts, a broad range of cutoff frequencies can be obtained. Experimental results are presented for three filters with cutoff frequencies of 0.75, 1.0, and 1.5 GHz. Each filter occupies a volume of about 0.5 in³. A physical interpretation of the conventional scaling transformation S =S'/ Omega/sub c/' is given for networks containing unit elements. Use of this transformation is shown to yield scaled networks containing microwave C sections rather than unit elements. Applications to broad-band impedance transformers are given and other possible applications are suggested.

Abstracts

Current Trends in Network Optimization

J.W. Bandler and R.E. Seviora. "Current Trends in Network Optimization." 1970 Transactions on Microwave Theory and Techniques 18.12 (Dec. 1970 [T-MTT] (1970 Symposium Issue)): 1159-1170.

Some current trends in automated network design optimization which, it is believed, will play a significant role in the computer-aided design of lumped-distributed and microwave networks are reviewed and discussed. In particular, the adjoint network approach due to Director and Rohrer for evaluating the gradient vector of suitable objective functions related to network responses that are to be opttilzed is presented in a tutorial manner. The advantage of this method is the ease with which the required partial derivatives with respect to variable parameters, such as electrical quantities or geometrical dimensions, can be obtained using at most two network analyses. Least pth and minimax approximation in the frequency domain are considered. Networks consisting of linear time-invariant elements are treated, including the conventional lumped elements, transmission lines, RC limes, coaxial lines, rectangular waveguides, and coupled lines. To illustrate the application of the adjoint network method, an example is given concerning the optimization in the least pth sense using the Fletcher-Powell method of a transmission-line filter with frequency variable terminations previously considered by Carlin and Gupta.

Abstracts

Ferrite Microstrip Phase Shifters with Transverse and Longitudinal Magnetization (Correspondence)

G.J. Buck. "Ferrite Microstrip Phase Shifters with Transverse and Longitudinal Magnetization (Correspondence)." 1970 Transactions on Microwave Theory and Techniques 18.12 (Dec. 1970 [T-MTT] (1970 Symposium Issue)): 1170-1173.

Phase shifts of opposing sign are produced in a finear section of microstrip by transverse and longitudinal magnetization of the ferrite substrate. Nonreciprocal phase shift is also produced by the transverse magnetization. Theoretical calculations of phase shift that account for both the diamagnetic effects and the tensor properties of the ferrite permeability agree well with properly constructed experimental measurements. These measurements use closed magnetic circuits to remove the nonuniform demagnetization effects. A lightweight reciprocal phase shifter has been constructed that utilizes both transverse and longitudinal magnetization at low drive power with closed magnetic circuits to obtain a high figure of merit.

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Parametric Amplification of Millimeter Waves Using Wafer Diodes: Results, Potentials, and Limitations (Correspondence)

J. Edrich. "Parametric Amplification of Millimeter Waves Using Wafer Diodes: Results, Potentials, and Limitations (Correspondence)." 1970 Transactions on Microwave Theory and Techniques 18.12 (Dec. 1970 [T-MTT] (1970 Symposium Issue)): 1173-1175.

Theoretical considerations and measurements on wafer varactors using Schottky-Barrier junctions show their feasibility for millimeter-wave and possibly low submilliieter-wave frequencies. A degenerate parametric amplifier is described which can be electronically tuned over a wide range (Delta/spl conint/=2 GHz) around 24 GHz and reaches a very low noise temperature (<70°K) when cooled.

Abstracts

Dielectric Resonators as Microstrip-Circuit Elements (Correspondence)

W.R. Day, Jr.. "Dielectric Resonators as Microstrip-Circuit Elements (Correspondence)." 1970 Transactions on Microwave Theory and Techniques 18.12 (Dec. 1970 [T-MTT] (1970 Symposium Issue)): 1175-1176.

Dielectric resonators are useful microstrip-circuit elements for applications requiring high Q and small size. A simple design procedure is presented which permits the rapid and accurate design of cylindrical resonators for microstrip circuits.

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K-Band Cryogenically Cooled Wide-Band Nondegenerate Parametric Amplifier (Correspondence)

S. Takahashi, M. Nojima, T. Fukuda and A. Yamada. "K-Band Cryogenically Cooled Wide-Band Nondegenerate Parametric Amplifier (Correspondence)." 1970 Transactions on Microwave Theory and Techniques 18.12 (Dec. 1970 [T-MTT] (1970 Symposium Issue)): 1176-1178.

The design and performance of a K-band cryogenically cooled wideband (600-MHz) low-noise (110°K) parametric amplifier for use in millimeter-wavelength satellite-communication earthterminal installations is described.

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Abstracts

Low-Noise Microstrip Mixer on a Plastic Substrate (Correspondence)

B.R. Hallford. "Low-Noise Microstrip Mixer on a Plastic Substrate (Correspondence)." 1970 Transactions on Microwave Theory and Techniques 18.12 (Dec. 1970 [T-MTT] (1970 Symposium Issue)): 1178-1181.

Design information is given for microstrip on a thin sheet of polyolefin that is reinforced with aluminum. A balanced 6-GHz-mixer-70-MHz-preamplifier design on this material is described. A single sideband noise figure less than 6 dB is obtained over the operating frequency range with no tuning adjustments.

Abstracts

Wide-Band X-Band Microstrip Image Rejection Balanced Mixer (Correspondence)

G.P. Kurpis and J.J. Taub. "Wide-Band X-Band Microstrip Image Rejection Balanced Mixer (Correspondence)." 1970 Transactions on Microwave Theory and Techniques 18.12 (Dec. 1970 [T-MTT] (1970 Symposium Issue)): 1181-1182.

A compact image rejection balanced mixer developed in microstrip medium is described. This integrated mixer gives over 20-dB image rejection and 10.6±0.6-dB noise figure (including 2.5-dB IF contribution) over 8-to 12-GHz range; it was designed on a 40-ohm impedance basis and is scalable to any 40-percent fractional bandwidth in the 1- to 12-GHz range.

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J.P. Agrios, G.D. Alley, J.W. Bandler, C.E. Barnes, M.J. Beaubien, F. Bosch, C.R. Boyd, Jr., R.M. Bulley, Z.J. Csendes, R.W. Jansen, Y. Kinoshita, R.H. Knerr, H. Kurebayashi, R. Levy, L. Lewin, M. Maeda, E.A. Mariani, S. Nakahara, B. Owen, R.E. Seviora, P. Silvester, J.D. Welch, R.J. Wenzel, A. Wexler, L.R. Whicker, A.E. Williams, O.M. Woodward and G.L. Yip. "Contributors (Dec. 1970 [T-MTT])." 1970 Transactions on Microwave Theory and Techniques 18.12 (Dec. 1970 [T-MTT] (1970 Symposium Issue)): 1183-1186.

Abstracts

Microwave Abstracts (Dec. 1970 [T-MTT])

"Microwave Abstracts (Dec. 1970 [T-MTT])." 1970 Transactions on Microwave Theory and Techniques 18.12 (Dec. 1970 [T-MTT] (1970 Symposium Issue)): 1187-1187.

Based on technical merit and timelines, microwave papers in journals published outside the United States have been selected and compiled below, generally with brief abstracts. Reprints of the papers may be obtained by writing directly to the author or to the source quoted.

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Abstracts

Rectangular Waveguides with Impedance Walls

R.B. Dybdal, L. Peters, Jr. and W.H. Peake. "Rectangular Waveguides with Impedance Walls." 1971 Transactions on Microwave Theory and Techniques 19.1 (Jan. 1971 [T-MTT]): 2-8.

The propagation of guided waves in a rectangular geometry having impedance boundary conditions is investigated. An impedance compatibility relation is derived that must be satisfied in order that a separable modal solution exists for a given impedance configuration. Several new rectangular waveguides are developed; among them are 1) a tall rectangular waveguide operating in a dominant H/sub 10/ mode with no H/sub 0N/ modes; 2) a rectangular waveguide with two parallel anisotropic impedance surfaces; 3) a rectangular waveguide with two parallel walls having isotropic impedance surfaces, the other two walls being anisotropic; 4) a rectangular waveguide supporting only E modes; and 5) rectangular coaxial systems containing impedance surfaces. The modal structure of rectangular waveguides with impedance boundary conditions offers advantages over the conventional waveguide. The potential of oversizing for low-loss and high-power applications is enhanced because of the additional modal control provided by the impedance surfaces. Other applications are suggested.

Abstracts

Vector Variational Solutions of Inhomogeneously Loaded Cylindrical Waveguide Structures

W.J. English. "Vector Variational Solutions of Inhomogeneously Loaded Cylindrical Waveguide Structures." 1971 Transactions on Microwave Theory and Techniques 19.1 (Jan. 1971 [T-MTT]): 9-18.

A vector variational formulation of the Maxwell curl equations in terms of all six electromagnetic field components is developed for circular waveguides symmetrically loaded with dialectric. A guide-wall boundary integral term, which renders the electric Dirichlet boundary conditions natural, is included in the variational expression. It is, therefore, unnecessary for the trial electromagnetic field functions to satisfy any guide-wall boundary conditions. This greatly extends the class of problems for which the vector variational-solution procedure is applicable and permits simple expansion functions for the trial fields, thus facilitating integral calculations. Solution results for several hybrid-mode circulator-waveguide structures are presented and compared with available experimental data.

Abstracts

Hybrid-Mode Analysis of Microstrip by Finite-Element Methods

P. Daly. "Hybrid-Mode Analysis of Microstrip by Finite-Element Methods." 1971 Transactions on Microwave Theory and Techniques 19.1 (Jan. 1971 [T-MTT]): 19-25.

A numerical analysis is presented in terms of finite elements of hybrid-mode propagation in closed microstrip. Two modes with zero frequency cutoff are described; one is a quasi-TEM mode and the other a surface mode. Also investigated is a third mode which corresponds to the lowest order waveguide mode in the absence of the strip.

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Abstracts

A Comb-Line Elliptic Filter

R. Levy and J.D. Rhodes. "A Comb-Line Elliptic Filter." 1971 Transactions on Microwave Theory and Techniques 19.1 (Jan. 1971 [T-MTT]): 26-29.

The design of a new type of elliptic filter, particularly suitable for narrow-band low-loss applications at VHF and UHF, is presented. The filter is derived from a lumped-element bandpass prototype by replacing the lumped inductors, which are normally the main contributory factors to the loss, by a comparatively low-loss distributed network. The latter consists of an n-wire digital line short-circuited at one end, the length of which is lambda/8 or less. An experimental elliptic filter of fifth order was constructed at 136.6 MHz with a pass bandwidth of 5 MHz, having 60-dB points at ±7 MHz from midband. The measured insertion loss of 1.1 dB is lower than that of a comparable lumped-element filter by a factor of at least 3.5:1. It compares favorably also with a comb-line filter, both in terms of loss and physical size.

Abstracts

A Frequency Dependent Solution for Microstrip Transmission Lines

E.J. Denlinger. "A Frequency Dependent Solution for Microstrip Transmission Lines." 1971 Transactions on Microwave Theory and Techniques 19.1 (Jan. 1971 [T-MTT]): 30-39.

Theoretical and experimental results of "open" microstrip propagation on both a pure dielectric and a demagnetized ferrite substrate are presented. The theory enables one to obtain the frequency dependence of phase velocity and characteristic impedance, and also to obtain the electromagnetic field quantities around the microstrip line. It utilizes a Fourier transform method in which the hybrid-mode solutions for a "fictitious" surface current at the substrate-air interface are summed in such a way as to represent the fields caused by a current distribution that is finite only over the region occupied by the conducting strip and is assumed equal to that for the quasi-static case.

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An E Vector Variational Formulation of the Maxwell Equations for Cylindrical Waveguide Problems

W.J. English and F.J. Young. "An E Vector Variational Formulation of the Maxwell Equations for Cylindrical Waveguide Problems." 1971 Transactions on Microwave Theory and Techniques 19.1 (Jan. 1971 [T-MTT]): 40-46.

A vector variational formulation of the Maxwell equations applicable to cylindrical waveguide problems is developed in terms of the electric E field. This three-component vector formulation allows an approximate solution of loaded waveguide structures which cannot be described in terms of a single-field component or potential function. The three-component formulation is more economical than corresponding six-component formulations for a given order of approximation because the solution matrices which result are reduced in size (/spl sim/1/2) and contain fewer zero elements. The E-field variational integral is expanded in terms of the field components for inhomogeneously loaded parallel-plate and rectangular waveguide geometries to illustrate a computer-assisted vector variational solution procedure.

Abstracts

A New Technique for the Analysis of the Dispersion Characteristics of Microstrip Lines

R. Mittra and T. Itoh. "A New Technique for the Analysis of the Dispersion Characteristics of Microstrip Lines." 1971 Transactions on Microwave Theory and Techniques 19.1 (Jan. 1971 [T-MTT]): 47-56.

Dispersion characteristics of shielded microstrip lines are investigated using a new technique. The method utilizes the well-known singular integral equation approach for deriving an alternate form of eigenvalue equation with superior convergence properties. It is shown that accurate numerical results may be obtained from this eigenvalue equation using only a 2x2 matrix equation. In comparison, the conventional formulation of the problem requires the use of matrices that are much larger in size. Aside from the numerical efficiency, the simplicity of the method makes it possible to conveniently extract higher order modal solutions for the propagation constants that affect the high-frequency application of microstrip lines. Even though the derivation of the determinantal equation requires some intricate mathematical manipulations, the user may bypass these completely and use the final eigenvalue equation which is programmable on the computer.

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Nonreciprocal Wave Propagation in Semiconductor Loaded Waveguides in the Presence of a Transverse Magnetic Field

R.M. Arnold and F.J. Rosenbaum. "Nonreciprocal Wave Propagation in Semiconductor Loaded Waveguides in the Presence of a Transverse Magnetic Field." 1971 Transactions on Microwave Theory and Techniques 19.1 (Jan. 1971 [T-MTT]): 57-65.

Approximate solutions for the complex propagation constant in semiconductor loaded waveguides are obtained by expansion of the fields in terms of a finite number of the empty waveguide modes. Solutions are obtained for the case of partial loading in the narrow dimension of the guide, which explicitly exhibit the non-reciprocal effects observed in the presence of a transverse magnetic field. Coupling between the TE/sub 10/ and TM/sub 11/ empty waveguide modes is shown to explain qualitatively the observed experimental effects. Good quantitative agreement with experiments using Si samples is obtained.

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Application of Ferrite to Electromagnetic Wave Absorber and its Characteristics (Jan. 1971 [T-MTT])

Y. Naito and K. Suetake. "Application of Ferrite to Electromagnetic Wave Absorber and its Characteristics (Jan. 1971 [T-MTT])." 1971 Transactions on Microwave Theory and Techniques 19.1 (Jan. 1971 [T-MTT]): 65-72.

An electromagnetic wave absorber utilizing ferrite or rubber ferrite composed of ferrite powder and rubber is described. In our investigation, the existence of a matching frequency f/sub m/ and a matching thickness t/sub m/ has been found. The terms f/sub m/ and t/sub m/ mean that the ferrite which is backed with a conducting plate can be a perfect absorber only under the conditions that the frequency of the incident wave is f/sub m/ and that the thickness of the ferrite is t/sub m/.Each ferrite has two matching frequencies f/sub m1/, f/sub m2/, (f/sub m1<f/sub m2/) and two matching thicknesses t/sub m1/, t/sub m2/, respectively. The f/sub m1/ of solid ferrite cannot be beyond 2 GHz. Through the development of rubber ferrite, the upper limit of f/sub m1/ can be overcome and f/sub m2/ ranges from 4 to 12 GHz. The matching thickness t/sub m1/ is a simple function of Snoek's value S and ranges from 4 to 10 mm regardless of f/sub m1/. The superiority of ferrite or rubber ferrite to lossy dielectric material as an absorber has been noticed in the frequency range under 7.5 GHz. The characteristics of matched load at 77°K was investigated with success.

Abstracts

Propagation in One-Dimensional Random Media

H.E. Rowe. "Propagation in One-Dimensional Random Media." 1971 Transactions on Microwave Theory and Techniques 19.1 (Jan. 1971 [T-MTT]): 73-80.

Propagation in one-dimensional random media is studied using matrix methods. This work applies, for example, to plane wave propagation in layered-media TEM transmission lines with random spacing, etc., where the spurious mode is a reflected wave. The imperfection is assumed to have a white spectrum. Similar techniques have previously been applied to multimode waveguide where the spurious mode is a forward wave. The present work is of interest because it yields exact computable results for certain transmission statistics in a simple way. These may be of help in comparing various approximate perturbation theories and in finding out what happens to signals in very long random transmission media where perturbation theory fails. Specifically, we compute the expected value and the variance of the complex loss (input/output) for lossless (i.e., zero heat loss) and lossy random media. In the lossless case only we compute the expected reciprocal input resistance and conductance, which Zakai has previously shown to be computable using a different approach. The imperfection (e.g., dielectric constant epsilon(x) of a continuous random medium, capacitance C(x) of a TEM line) is assumed to consist of a dc component and a white ac component. The more practical case of a flat low-pass spectrum for the ac component is considered, and the region of applicability of the present results to this problem is indicated. Similar methods may be used to calculate the covariance of the (complex) loss and higher moments of the loss and of the reciprocal input resistance and conductance for zero heat loss, although these calculations are not carried out here. The covariance would be required in order to study signal distortion in such a random medium.

Abstracts

A New Method of Synthesizing Matched Broad-Band TEM-Mode Three-Ports

R.B. Ekinge. "A New Method of Synthesizing Matched Broad-Band TEM-Mode Three-Ports." 1971 Transactions on Microwave Theory and Techniques 19.1 (Jan. 1971 [T-MTT]): 81-88.

A new method of synthesizing matched broad-band TEM-mode three-ports is presented. The three-ports consist of n sections in cascade with each section composed of two coupled lossless transmission lines of electrical length theta and an intermediate resistor. The main object is to analyze and design broad-band unsymmetrical structures with the symmetrical three-port as a special and important case. The analysis of the three-port is performed by means of a more convenient four-port analysis. An even-odd-mode method is used and a new definition of the odd mode is introduced. This new definition considerably simplfies the treatment of unsymmetrical three-and four-ports with one half of the network identical to the other apart from an impedance scaling factor. The analysis yields two uncoupled two-ports in each mode. The even-mode networks are identical with cascaded quarter-wave impedance transformers while the odd-mode networks contain all the resistors. A new technique for their design is presented and a computer program for complete synthesis of hybrid three-ports has been worked out. Several experimental stripline three-ports were built. A three-section unsymmetrical (k=1.7) matched three-port showed a measured isolation better than 20 dB and a maximum VSWR of 1.3 from 5 to 12 GHz. The total loss of a four-section equal-power divider was 0.2dB, maximum VSWR 1.25, and minimum isolation 23 dB over the frequency range 2.5-12.0 GHz.

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Operating Criteria for Active Microwave Inductors (Correspondence)

E. Fliegler. "Operating Criteria for Active Microwave Inductors (Correspondence)." 1971 Transactions on Microwave Theory and Techniques 19.1 (Jan. 1971 [T-MTT]): 89-91.

A method is given whereby the range of frequencies of operation of an inverted common collector transistor circuit (synthesized inductance) is found experimentally as a function of bias current. A complementary relationship is shown to exist between this method and that which gives the frequency range by determining the maximum reflected negative resistance characteristics.

Abstracts

Grid-Separated Microwave Triode Oscillators---Analysis and Design (Correspondence)

R.J. Chaffin. "Grid-Separated Microwave Triode Oscillators---Analysis and Design (Correspondence)." 1971 Transactions on Microwave Theory and Techniques 19.1 (Jan. 1971 [T-MTT]): 91-93.

A grid-separated microwave triode oscillator which uses a common capacitance as the feedback element is examined. This particular design lends itself to a straightforward theoretical analysis which is shown to be in good agreement with experimental results at 2.5 GHz.

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Contribution to the Problem of Orthogonality Relations for Magnetoplasma-Filled Waveguides (Correspondence)

C. Vassallo. "Contribution to the Problem of Orthogonality Relations for Magnetoplasma-Filled Waveguides (Correspondence)." 1971 Transactions on Microwave Theory and Techniques 19.1 (Jan. 1971 [T-MTT]): 93-94.

The orthogonality properties of the modes of a magnetoplasma waveguide involve a set of adjoint modes. We show how to obtain these adjoint modes without calculus in some particular cases.

Abstracts

Balanced Transmission-Line Measurements Using Coaxial Equipment (Correspondence)

J.D. Dyson and R. Ginyovszky. "Balanced Transmission-Line Measurements Using Coaxial Equipment (Correspondence)." 1971 Transactions on Microwave Theory and Techniques 19.1 (Jan. 1971 [T-MTT]): 94-96.

The availability of commercial precision coaxial hybrids makes measurements on balanced two-conductor transmission lines as easy and as practical as on an unbalanced coaxial system. These hybrids, when used as a balun, transform an unbalanced coaxial system to a balanced shielded system and because of the nature of the balanced shielded system permit the measurement of the characteristics of loads connected thereto by the use of commercial coaxial test equipment. This technique has been successfully used from 600 MHz to 5 GHz, and with presently available components can be used at HF and VHF as well. The theory upon which the measurement technique is based is outlined and some results of an experimental verification included.

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The Generation of Pulse-Modulated Signals at C Band and Beyond (Correspondence)

G.F. Ross. "The Generation of Pulse-Modulated Signals at C Band and Beyond (Correspondence)." 1971 Transactions on Microwave Theory and Techniques 19.1 (Jan. 1971 [T-MTT]): 96-99.

A method is presented to generate pulse-modulated signals at C band and beyond where the pulse duration may be in the order of a nanosecond. The generation technique involves the use of a TEM-mode pulse-forming network having a time-limited impulse response and a source of step-modulated RF energy.

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Design of a Tapered Transition in a Circular Waveguide (Correspondence)

P.S. Christensen. "Design of a Tapered Transition in a Circular Waveguide (Correspondence)." 1971 Transactions on Microwave Theory and Techniques 19.1 (Jan. 1971 [T-MTT]): 99-100.

This correspondence describes a successful design procedure for transitions in circular waveguide. The design procedure is discussed and a universal design curve developed. As an example, one point on a 12-in taper from WRC 283 (2.81-in ID) to WRC 621 (1.28-in ID) is calculated. Test results for the 12-in taper in the 5.925-to 6.425-GHz common carrier band are given.

Abstracts

1-M W Four-Port E-Plane Junction Circulator (Correspondence)

E.E. DeCamp, Jr. and R.M. True. "1-M W Four-Port E-Plane Junction Circulator (Correspondence)." 1971 Transactions on Microwave Theory and Techniques 19.1 (Jan. 1971 [T-MTT]): 100-103.

An S-band four-port E-plane waveguide junction circulator has been developed that has a power-handling capability of 1-MW peak and 1-kW average. Improved ferrite materials and dielectric matching techniques have resulted in a device having a high-power insertion loss of 0.5 dB and a biasing magnetic field of 400 G. The E-plane configuration lends itself to a compact lightweight circulator design having a high-power capability greater than the H-plane configuration, since RF breakdown problems are alleviated by locating the ferrite in the region of minimum RF electric field. The final device requires approximately one-tenth the amount of ferrite and permanent magnet material used in comparable differential phase-shift circulators. The size and weight are reduced by a factor of approximately 5.

Abstracts

A 360° Reflection-Type Diode Phase Modulator (Correspondence)

B.T. Henoch and P. Tamm. "A 360° Reflection-Type Diode Phase Modulator (Correspondence)." 1971 Transactions on Microwave Theory and Techniques 19.1 (Jan. 1971 [T-MTT]): 103-105.

A 360° phase modulator using two series-tuned varactors in a parallel connection is described. The design minimizes the change in total phase shift with frequency and gives a small attenuation ripple. The modulator is centered at 2 GHz and gives a total phase shift at 360° at the center frequency, an attenuation ripple of 1.3 dB over a 10-percent bandwidth and a 7° decrease of phase shift at the band edges.

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A Comparison of Two Nonreciprocal Latching Phaser Configurations (Correspondence)

W.J. Ince, J. DiBartolo, D.H. Temme and F.G. Willwerth. "A Comparison of Two Nonreciprocal Latching Phaser Configurations (Correspondence)." 1971 Transactions on Microwave Theory and Techniques 19.1 (Jan. 1971 [T-MTT]): 105-107.

The microwave and switching characteristics of the rectangular-toroid latching-ferrite-phaser configuration are compared and contrasted with those of the circumferentially magnetized circular rod in rectangular waveguide.

Abstracts

Rays, Modes, and Equivalent Networks (Correspondence)

L.B. Felsen. "Rays, Modes, and Equivalent Networks (Correspondence)." 1971 Transactions on Microwave Theory and Techniques 19.1 (Jan. 1971 [T-MTT]): 107-109.

This correspondence describes certain analogies between ray-optical and modal (equivalent-network) procedures employed in the study of a variety of propagation, guiding, and scattering phenomena.

Abstracts

Input Impedance Behavior of Stripline Circulator (Correspondence)

S.J. Salay and H.J. Peppiatt. "Input Impedance Behavior of Stripline Circulator (Correspondence)." 1971 Transactions on Microwave Theory and Techniques 19.1 (Jan. 1971 [T-MTT]): 109-110.

The input impedance of the Bosma model for a stripline circulator has been computed for light coupling in below-resonance operation. The result agrees with the two-tank circuit model proposed by Fay and Comstock and with experimental measurements.

Abstracts

Eigenvalues for a Spherical Cavity with an Impedance Wall (Correspondence)

P. Bhartia and M.A.K. Hamid. "Eigenvalues for a Spherical Cavity with an Impedance Wall (Correspondence)." 1971 Transactions on Microwave Theory and Techniques 19.1 (Jan. 1971 [T-MTT]): 110-111.

The boundary value solution for the resonance frequencies of a spherical cavity with an impedance wall is presented for the TE and TM cases. It is found that in the TE case with a capacitive cavity surface, a new mode exists and corresponds to the fundamental mode. This is in contrast to the perfectly conducting spherical cavity where a TM mode is the lowest order mode.

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Identification of Spurious Modes in Circulators (Correspondence)

J.B. Castillo and L.E. Davis. "Identification of Spurious Modes in Circulators (Correspondence)." 1971 Transactions on Microwave Theory and Techniques 19.1 (Jan. 1971 [T-MTT]): 112-113.

The spurious, and sometimes troublesome spikes in circulator characteristics are shown by analysis and experiment to be due to hybrid resonant modes of the ferrite post open-resonator structure. They can be excited by axial nonuniformities such as imperfect contact between the ferrite and the conducting walls, but they cannot exist in axially uniform structures with axially uniform excitation.

Abstracts

Conductivity and the Microwave Properties of 81-Permalloy Thin Films (Correspondence)

R.H. Havemann and L.E. Davis. "Conductivity and the Microwave Properties of 81-Permalloy Thin Films (Correspondence)." 1971 Transactions on Microwave Theory and Techniques 19.1 (Jan. 1971 [T-MTT]): 113-116.

The microwave properties of 81-Permalloy (81 percent nickel-19 percent iron) films less than 1050 Aring thick and without an external magnetic field have been studied at 10 GHz. The measured dc conductivity values sigma/sub m/ were approximately one-half the values (sigma/sub m/) predicted by the Fuchs-Sondheimer (F-S) theory for monovalent metals, and an indirect check was obtained by comparing measured reflection and transmission coefficients (R and T) with values calculated using sigma/sub m/ and sigma/sub s/. The power transmission coefficient was obtained from the insertion loss, and calculated values of insertion loss using sigma/sub m/ agreed within 2 percent with directly measured values. Calculated values of R using sigma/sub m/ showed good agreement with directly measured values for film thicknesses less than 300 /spl Aring/, but with thicknesses between 300 /spl Aring/ and 1050 /spl Aring/ the directly measured values of R were up to 5 percent smaller than those predicted using sigma/sub m/. Using the F-S conductivity, calculated values of T were approximately an order of magnitude lower than directly measured values, and calculated values of R were as much as 13 percent higher than directly measured values.

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Characteristics of Oversize Circular Waveguides and Transitions at 3-mm Wavelengths (Correspondence)

H.E. King and J.L. Wong. "Characteristics of Oversize Circular Waveguides and Transitions at 3-mm Wavelengths (Correspondence)." 1971 Transactions on Microwave Theory and Techniques 19.1 (Jan. 1971 [T-MTT]): 116-119.

The physical and electrical characteristics of a 0.995-in-diameter oversize circular waveguide and its associated transitions operating in the 92- to 96-GHz band are described. Both linear and nonlinear taper transitions were employed in converting from the WR-10 dominant-mode rectangular waveguide (0.100 by 0.050 in ID) to a 0.995-in-diameter circular waveguide. The results of the present investigations indicate that the nonlinear taper transitions yield considerably less multimoding effects. The measured attenuation for a 0.995-in-diameter oversize copper circular waveguide is 0.028 dB/ft as compared to a theoretical value of 0.02 dB/ft.

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Manganese Substitution in Garnets for Remanent Phase Shifters (Correspondence)

A.S. Hudson, J. Sneider and J.W.F. Dorleijn. "Manganese Substitution in Garnets for Remanent Phase Shifters (Correspondence)." 1971 Transactions on Microwave Theory and Techniques 19.1 (Jan. 1971 [T-MTT]): 119-120.

Results of experiments to determine the effect of small manganese substitution on the properties of mixed yttrium-gadolinium garnets are reported. The composition Y/sub 2.1/Gd/sub 0.9/Fe/sub 5-z/ Mn/sub z/0/sub 12/ (0<z<0.15) has been investigated, and the variation of remanent properties, resonance linewidth, and dielectric loss tangent are given. It is shown that the use of manganese can lead to a significant reduction in the variation of remanent phase shift with external stress, and the composition with z = 0.15 is shown to be comparable with magnesium-manganese-aluminium spinel in this respect.

Abstracts

Analysis of Thick-Strip Transmission Lines (Correspondence)

E. Yamashita and K. Atsuki. "Analysis of Thick-Strip Transmission Lines (Correspondence)." 1971 Transactions on Microwave Theory and Techniques 19.1 (Jan. 1971 [T-MTT]): 120-122.

A method for analyzing general thick-strip transmission lines is reported. Calculated characteristic impedances based on this method are consistent with other theory and experiment in the case of thick-strip microstrip lines. The case of thick-strip lines with three dielectric layers and shielding is also presented.

Abstracts

An Explicit Solution for the Scattering Parameters of a Linear Two-Port Measured with an Imperfect Test Set (Correspondence)

W. Kruppa and K.F. Sodomsky. "An Explicit Solution for the Scattering Parameters of a Linear Two-Port Measured with an Imperfect Test Set (Correspondence)." 1971 Transactions on Microwave Theory and Techniques 19.1 (Jan. 1971 [T-MTT]): 122-123.

Formulas are derived for the direct calculation of the scattering parameters of a linear two-port, using measurements made on a test set having residual, tracking, and mistermination errors. The problem is formulated by representing the measuring system in terms of scattering parameters. Solutions using this formulation have previously been obtained only in an implicit manner using an iterative approach. The associated calibration procedure is included.

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R.M. Arnold, P. Daly, E.J. Denlinger, R.B. Dybdal, R.B. Ekinge, W.J. English, T. Itoh, R. Levy, R. Mittra, Y. Naito, W.H. Peake, L. Peters, Jr., J.D. Rhodes, F.J. Rosenbaum, H.E. Rowe, K. Suetake and F.J. Young. "Contributors (Jan. 1971 [T-MTT])." 1971 Transactions on Microwave Theory and Techniques 19.1 (Jan. 1971 [T-MTT]): 123-125.

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Information on Computer Program Descriptions (Jan. 1971 [T-MTT])

"Information on Computer Program Descriptions (Jan. 1971 [T-MTT])." 1971 Transactions on Microwave Theory and Techniques 19.1 (Jan. 1971 [T-MTT]): 126-126.

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Editor's Note (Feb. 1971 [T-MTT])

G.I. Haddad. "Editor's Note (Feb. 1971 [T-MTT])." 1971 Transactions on Microwave Theory and Techniques 19.2 (Feb. 1971 [T-MTT] (Special Issue on Biological Effects of Microwaves)): 2-2.

With the increasing usage of microwaves in industrial and civilian applications, it is essential that their biological effects be determined and understood. It is hoped that this issue will acquaint the microwave engineer with the present understanding of these problems and the work which is being carried out in this area. It will also become apparent that this is a fertile field for research, and microwave engineers can certainly contribute to the understanding of these problems if they wish to get involved.

Abstracts

Guest Editorial (Feb. 1971 [T-MTT])

J.M. Osepchuk. "Guest Editorial (Feb. 1971 [T-MTT])." 1971 Transactions on Microwave Theory and Techniques 19.2 (Feb. 1971 [T-MTT] (Special Issue on Biological Effects of Microwaves)): 2-3.

This special issue is devoted to a survey of existing knowledge and continuing research on the biological effects of microwaves. There has been a substantial amount of research in the past in this field, and in the early part of the last decade it was generally believed that an adequate understanding and practical control via safety standards had been achieved. In recent years the resurgence of the microwave oven and the industrial application of microwaves, together with the somewhat accidental broadening by Congress of legislation directed toward control of color television X-rays has posed new questions on the adequacy of our knowledge of the biological effects of microwaves and on our ability to protect the general public as well as occupational personnel from adverse effects of microwave radiation.

Abstracts

Introductory Remarks (Feb. 1971 [T-MTT])

W.W. Mumford. "Introductory Remarks (Feb. 1971 [T-MTT])." 1971 Transactions on Microwave Theory and Techniques 19.2 (Feb. 1971 [T-MTT] (Special Issue on Biological Effects of Microwaves)): 130-130.

This Special Issue on the Biological Effects of Microwaves is particularly timely. Public Law 90-602, known as the "Radiation Control for Health and Safety Act of 1968", was adopted by the 90th Congress on October 18, 1968. The purpose was to protect the public health and safety from the dangers of electronic product radiation. Microwave generators fall under the purview of this legislation.

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The Tri-Service Program--A Tribute to George M. Knauf, USAF (MC)

S.M. Michaelson. "The Tri-Service Program--A Tribute to George M. Knauf, USAF (MC)." 1971 Transactions on Microwave Theory and Techniques 19.2 (Feb. 1971 [T-MTT] (Special Issue on Biological Effects of Microwaves)): 131-146.

During World War II, the Department of Defense medical services became interested and concerned about possible hazards associated with the development, operation, and maintenance of the increasing numbers of radars and other radio-frequency emitting electronic equipment. After some investigations by the U. S. Navy and the U. S. Air Force, responsibility for research on the biomedical aspects of microwave radiation was delegated in July, 1957, as a tri-service arrangement to Rome Air Development Center, Griffiss Air Force Base, N. Y. Primary responsibility for coordination of the program rested with Dr. George M. Knauf, USAF (MC). The Tri-Service Program included investigation of effects of exposure of the whole-body, selected organs and tissues, single cells, and enzyme systems using various power levels, pulsed and continuous wave, in the frequency spectrum from 200 through 24 500 MHz under acute, subacute, and chronic conditions. The most important contribution of the Tri-Service Program was the validation of the 10-mW/cm safety standard. The Tri-Service Program is to date the only large-scale coordinated effort in the Western world to elucidate and understand some of the basic mechanisms of microwave bioeffects and to assess possible health implications of this form of energy. This paper constitutes an overview of the Tri-Service Program to provide some historical insight into the significance of the program and its contributions to our understanding of the biologic effects of microwaves. The initiative, foresight, and drive of Colonel Knauf was an immeasurable contribution to the success of the program.

Abstracts

Interaction of Microwave and Radio Frequency Radiation with Biological Systems

H.P. Schwan. "Interaction of Microwave and Radio Frequency Radiation with Biological Systems." 1971 Transactions on Microwave Theory and Techniques 19.2 (Feb. 1971 [T-MTT] (Special Issue on Biological Effects of Microwaves)): 146-152.

A survey of thermal and nonthermal effects is presented with some recommendations for future work. A basis of all biophysical considerations are the electrical properties including dielectric constants and conductivities for nearly all body tissues. Equations are presented which summarize previous experimental work and state dielectric constant and conductivity for tissues of high water content as functions of macromolecular content and frequency. No evidence is available supporting resonance behavior. Previous thermal work includes determination of depth of penetration values and the relative absorption cross section of man and was the basis for present standards. Nonthermal principles which explain many previous observations are largely due to field-induced forces. Such effects occur in the human body only at field-strength levels which are thermally dangerous. Several important conclusions are made. 1) Field-force effects cannot be enhanced by use of pulsed fields. 2) It is not possible to directly stimulate nerve membranes by microwave fields. 3) It is fluids and tissues. Finally, a guideline for future standard work in complex fields is proposed. It is based on the concept of a tolerance current density, which is stated to be near 3 mA/cm between 1 and 1000 MHz. The biophysical principles which pertain to the interaction of nonionizing electromagnetic radiations with biological systems are not discussed. This was done in the past on several occasions. The field will be summarized only briefly and attention will be given to problems not already delt with satisfactorily. We intend to concentrate on some topics that are presently of particular interest.

Abstracts

Biological Function as Influenced by Low-Power Modulated RF Energy

A.H. Frey. "Biological Function as Influenced by Low-Power Modulated RF Energy." 1971 Transactions on Microwave Theory and Techniques 19.2 (Feb. 1971 [T-MTT] (Special Issue on Biological Effects of Microwaves)): 153-164.

In recent years it has been recognized that low-power-density modulated RF energy can affect the functioning of higher living organisms. In this paper the sparse data generated in the western hemisphere on this subject are considered, the reasons for their sparseness are noted, and the hypotheses on mechanisms that may provide an explanation for the observed effects and other possible effects are sketched. Possible conclusions with regard to hazards to personnel are then considered.

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Microwave Radiation Safety Standards in Eastern Europe

K. Marha. "Microwave Radiation Safety Standards in Eastern Europe." 1971 Transactions on Microwave Theory and Techniques 19.2 (Feb. 1971 [T-MTT] (Special Issue on Biological Effects of Microwaves)): 165-168.

Research in Eastern Europe on biological effects of microwaves is briefly reviewed and a basic viewpoint involving non-thermal and cumulative effects is presented. Safety standards expressed in terms of dose or irradiation are described based on this viewpoint. It is suggested that differences between these standards and those in the West may become smaller with further study and closer collaboration between researchers in this field.

Abstracts

Absence of Heart-Rate Effects in Rabbits During Low-Level Microwave Irradiation

I.T. Kaplan, W. Metlay, M.M. Zaret, L. Birenbaum and S.W. Rosenthal. "Absence of Heart-Rate Effects in Rabbits During Low-Level Microwave Irradiation." 1971 Transactions on Microwave Theory and Techniques 19.2 (Feb. 1971 [T-MTT] (Special Issue on Biological Effects of Microwaves)): 168-173.

Soviet studies have reported that low-level microwave irradiation alters the heart rate of humans and animals. In a replication of one such study, 16 rabbits were exposed to dorsal irradiation n of the head by 2.4-GHz CW. microwaves at a power density of 10 mW/cm² for 20 min. The rest of the animal's body was shielded by absorbent material. There was no significant difference between the heart rate during or after irradiation and the heart rate of the same animals during a control condition in which they were not irradiated. Analysis of the variability in heart rate observed in this experiment suggested that the heart-rate effects reported in the original Soviet study might have been chance variations. In a second experiment, heart rate, respiration rate, and body temperature were recorded simultaneously while each of two rabbits was irradiated as before, on the dorsal aspect of the head only, at various power densities from 0 to 100 mW/cm², in steps of 20 mW/cm². Respiration rate increased during irradiation at 40 mW/cm², body temperature rose at 80 mW/cm², and ultimately the heart rate also increased, but only at 100 mW/cm².

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Evidence For Nonthermal Effects of Microwave Radiation: Abnormal Development of Irradiated Insect Pupae

R.L. Carpenter and E.M. Livstone. "Evidence For Nonthermal Effects of Microwave Radiation: Abnormal Development of Irradiated Insect Pupae." 1971 Transactions on Microwave Theory and Techniques 19.2 (Feb. 1971 [T-MTT] (Special Issue on Biological Effects of Microwaves)): 173-178.

Several investigators have reported experiments in which microwave radiation caused biological damage at tissue temperatures which were not harmful when brought about by means other than microwaves. To study the effects of 10-GHz CW radiation on a poikilothermic invertebrate animal, we irradiated early pupae of the mealworm beetle, Tenebrio molitor. Each pupa was inserted in a waveguide and irradiated therein at waveguide powers of 80 mW for either 20 or 30 min or at 20 mW for 120 min, after which their subsequent development was observed. In control groups similarly treated, except that no microwave power was applied, 90 percent metamorphosed to become normal adult beetles. In the irradiated groups only 24 percent developed normally; 25 percent died and 51 percent developed abnormally. In half of the abnormal animals, the front half had undergone metamorphosis to form a normal beetle head and thorax but the hind part remained in the pupal state. Temperature increases within pupae were recorded during irradiation. When these thermal conditions were duplicated by means of radiant heating, subsequent development of pupae was normal in 80 percent of the experiments. We therefore concluded that the abnormalities induced by microwave radiation were not a thermal effect.

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Quantifying Hazardous Electromagnetic Fields: Scientific Basis and Practical Considerations

P.F. Wacker and R.R. Bowman. "Quantifying Hazardous Electromagnetic Fields: Scientific Basis and Practical Considerations." 1971 Transactions on Microwave Theory and Techniques 19.2 (Feb. 1971 [T-MTT] (Special Issue on Biological Effects of Microwaves)): 178-187.

As commonly recognized, the problem of quantifying hazardous electromagnetic (EM) fields is difficult and has not yet been satisfactorily solved. Essentially, this is because people are often exposed to emanations from powerful sources of EM fields at points close to the sources and at points where arbitrary polarization and multipath interference exist. However, the accepted concepts, standards, and most measuring instrumentation are based on simple plane-wave field propagation and so are inadequate for complicated fields. The complications and problems of quantifying hazardous EM fields involving source-subject coupling, reactive near-field components, multipath components, and arbitrary polarization are examined in some detail General discussion of dosimetric measurements and hazard survey measurements is given, and also some basic considerations for the design of field probes for these measurements. Recommendations are given for suitable parameters for quantifying complicated EM fields, and essential and desirable characteristics for hazard survey meters are stated. Several recently designed hazard survey probes are capable of measuring these recommended parameters in many complicated fields of interest, and improved instruments are anticipated.

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Induced Fields and Heating Within a Cranial Structure Irradiated by an Electromagnetic Plane Wave

A.R. Shapiro, R.F. Lutomirski and H.T. Yura. "Induced Fields and Heating Within a Cranial Structure Irradiated by an Electromagnetic Plane Wave." 1971 Transactions on Microwave Theory and Techniques 19.2 (Feb. 1971 [T-MTT] (Special Issue on Biological Effects of Microwaves)): 187-196.

The induced fields and the static heating patterns within a multilayered spherical model that approximates the primate cranial structure irradiated by plane waves in the microwave spectrum are calculated. The relation of the model to the biological structure and the sensitivity of the results to the uncertainties in the dimensions and electrical properties of biological material are investigated. A method of solution for both the scattered and the interior fields for a sphere with an arbitrary number of electrically different concentric layers is developed in a form readily amenable to machine computation. It is shown that the semi-infinite slab model is inappropriate for calculating the microwave radiation dosage for the human head and similar structures.

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New Techniques for Implementing Microwave Biological-Exposure Systems

H.L. Bassett, H.A. Ecker, R.C. Johnson and A.P. Sheppard. "New Techniques for Implementing Microwave Biological-Exposure Systems." 1971 Transactions on Microwave Theory and Techniques 19.2 (Feb. 1971 [T-MTT] (Special Issue on Biological Effects of Microwaves)): 197-204.

In investigating the biological effects of microwave radiation, one of the most vexing problems is that of generating an essentially uniform plane wave with sufficient power density for illuminating biological samples. This paper describes three illumination systems: a focused prolate spheroid, an absorber-lined horn, and a compact range. The focused prolate spheroid has two foci: a waveguide feed is located at one, and the biological sample is located at the other. Large power densities can be obtained over an area of about one square wavelength. The absorber-limed horn acts as a small source within an anechoic chamber; such an illumination system reduces errors due to interaction with the biological sample. The compact range employs a reflector and feed system to generate a plane wave across a large aperture; such a range is an attractive device for illuminating large volumes. All three systems can be implemented in a limited space without an anechoic chamber. Experimental data obtained from model systems are presented.

Abstracts

Analyses of Electromagnetic Fields Induced in Biological Tissues by Thermographic Studies on Equivalent Phantom Models

A.W. Guy. "Analyses of Electromagnetic Fields Induced in Biological Tissues by Thermographic Studies on Equivalent Phantom Models." 1971 Transactions on Microwave Theory and Techniques 19.2 (Feb. 1971 [T-MTT] (Special Issue on Biological Effects of Microwaves)): 205-214.

One of the most vexing problems in studies involving the interaction of electromagnetic fields and living biological systems and tissues is the quantification of the fields induced in the tissues by nearby sources. This paper describes a method for rapid evaluation of these fields in tissues of arbitrary shape and characteristics when they are exposed to various sources including plane wave, aperture, slot, and dipole sources. The method, valid for both far- and near-zone fields, involves the use of a thermograph camera for recording temperature disitributions produced by energy absorption in phantom models of the tissue structures. The magnitude of the electric field may then be obtained anywhere on the model as a function of the square root of the magnitude of the calculated heating pattern. The phantoms are composed of materials with dielectric and geometric properties identical to the tissue structures which they represent. The validity of the technique is verified by comparing the results of the experimental approach with the theoretical results obtained for the case of plane layers of tissue exposed to a rectangular aperture source and cylindrical layers of tissue exposed to a plane-wave source. This technique has been used successfully by the author for improving microwave applicators.

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Electromagnetic Fields and Relative Heating Patterns Due to a Rectangular Aperture Source in Direct Contact with Bilayered Biological Tissue

A.W. Guy. "Electromagnetic Fields and Relative Heating Patterns Due to a Rectangular Aperture Source in Direct Contact with Bilayered Biological Tissue." 1971 Transactions on Microwave Theory and Techniques 19.2 (Feb. 1971 [T-MTT] (Special Issue on Biological Effects of Microwaves)): 214-223.

Expressions are derived and evaluated for the electro-magnetic fields and associated relative heating patterns in two-layered biological tissue media exposed to a direct-contact rectangular aperture source. The source consists of a linearly polarized electric field distribution specified in the plane of the aperture. The results may be used for many biomedical applications ranging from the design of diathermy applicators to the establishment of standardized electromagnetic field intensities in connection with research on electromagnetic effects in living biological media.

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Microwave Heating of Simulated Human Limbs by Aperture Sources

H.S. Ho, A.W. Guy, R.A. Sigelmann and J.F. Lehmann. "Microwave Heating of Simulated Human Limbs by Aperture Sources." 1971 Transactions on Microwave Theory and Techniques 19.2 (Feb. 1971 [T-MTT] (Special Issue on Biological Effects of Microwaves)): 224-231.

Microwave heating of phantom models of human limbs by aperture sources is investigated theoretically and experimentally. These phantom models consist of triple-layered circular lossy dielectric cylinders. The three layers of dielectric materials simulate human tissues of fat, muscle, and bone. In the theoretical investigation, apertures operating in the frequency range of 433 to 2450 MHz are used as microwave sources for heating the dielectric materials. The theoretical investigation makes use of the technique of summation of cylindrical waves. A high-speed computer is used to calculate the numerical results. For the experimental investigation, an aperture is designed and built to operate at the frequency of 918 MHz. The resulting temperature patterns in the phantom models are detected by the use of a thermograph camera. The theoretical results are shown to be in agreement with the experimental results. The technique and results of this investigation may be applied towards the design of applicators for therapeutic heating of human tissues.

Abstracts

Determination and Elimination of Hazardous Microwave Fields Aboard Naval Ships

Z.R. Glaser and G.M. Heimer. "Determination and Elimination of Hazardous Microwave Fields Aboard Naval Ships." 1971 Transactions on Microwave Theory and Techniques 19.2 (Feb. 1971 [T-MTT] (Special Issue on Biological Effects of Microwaves)): 232-238.

A qualitative description of the way that the problems of radio frequency and microwave radiation hazards to personnel aboard Naval ships have been handled is presented. The prediction and measurement of microwave fields produced by typical equipment used for communication, command and control, surveilance, fire control, and naviagtion are discussed. A hazard evaluation survey conducted aboard a fictitious ship, which closely parallels that performed on actual ships, is described. Mentioned are the various methods and techniques used to define and control the potentially hazardous environment which is unique to the Navy.

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Selective Electromagnetic Heating of Tumors in Animals in Deep Hypothermia

R.P. Zimmer, H.A. Ecker and V.P. Popovic. "Selective Electromagnetic Heating of Tumors in Animals in Deep Hypothermia." 1971 Transactions on Microwave Theory and Techniques 19.2 (Feb. 1971 [T-MTT] (Special Issue on Biological Effects of Microwaves)): 238-245.

A technique for heating tumors with microwave energy has been developed to achieve differential hypothermia in laboratory animals. In the differential hypothermia technique, a temperature difference of about 25°C is maintained between the tumor and the body with the tumor being at normal body temperature. While the animal is in this deep differential hypothermic state, chemotherapeutic drugs are administered to treat the tumor. For large tumors, the technique was implemented with S-band equipment and for smaller tumors it was implemented with X-band equipment. Both systems employ a feed or probe designed for use with the particular system. Results are presented that show the applicability of microwave energy in the selective heating of tumors.

Abstracts

Prolongation of Life During High-Intensity Microwave Exposures

G.M. Samaras, L.R. Muroff and G.E. Anderson. "Prolongation of Life During High-Intensity Microwave Exposures." 1971 Transactions on Microwave Theory and Techniques 19.2 (Feb. 1971 [T-MTT] (Special Issue on Biological Effects of Microwaves)): 245-247.

In an attempt to determine whether environmental control would be a feasible and effective tool with which to further investigate microwave bioeffects, we have performed a pilot study. Osborne-Mendel rats were exposed in a lucite environmental chamber, continually flushed with liquid-nitrogen-cooled air. The results of this study indicate that ambient air temperature control can provide a means for prolonging life in test subjects exposed to high-intensity microwave fields. Dosimetric considerations are presented in an attempt to relate heating curves to exposure conditions.

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Electromagnetic Fields and the Life Environment (Book Reviews)

C. Susskind. "Electromagnetic Fields and the Life Environment (Book Reviews)." 1971 Transactions on Microwave Theory and Techniques 19.2 (Feb. 1971 [T-MTT] (Special Issue on Biological Effects of Microwaves)): 248-248.

At the USPHS-sponsored Symposium on the Biological Effects and Health Implications of Microwave Radiation held in Richmond, Va., in 1969, the paper that created the greatest interest was given by Karel Marha, Chief of the High-Frequency Department of the Institute of Industrial Hygiene and Occupational Diseases in Prague, who dealt with the maximum values of nonionizing radiation permissible in Czechoslovakia, a country that has tried to bridge the gap between the 10-mW/cm² U.S. standard and the much stricter Soviet standard. The Czechoslovak standards are stated in terms of the maximum permissible daily dose, given as the product specifically concerned with microwaves or radio waves and still less of field intensity (in volts/meter) and time (in hours) below 300 MHz, and as the product of power density (in microwatt per square centimeter) and time (in hours) above 300 MHz. (The values: above 300 MHz CW, 200 for personnel and 60 for the public; average pulsed, 80 for personnel and 24 for the public; below 300 MHz, 80 for personnel and 24 for the public; and below 30 MHz, 400 for personnel and 120 for the public.)

Abstracts

Electromagnetic Fields and Life (Book Review)

C. Susskind. "Electromagnetic Fields and Life (Book Review)." 1971 Transactions on Microwave Theory and Techniques 19.2 (Feb. 1971 [T-MTT] (Special Issue on Biological Effects of Microwaves)): 248-248.

This book, by the Russian biophysicist who has been a leader in the study of the effects of electromagnetic fields on living organisms, is less practically and more scientifically oriented than the Czech volume just reviewed and as such will be of primary interest to research scientists, particularly well-heeled ones.

Abstracts

Electromagnetic Radiation Meter (Correspondence)

E.E. Aslan. "Electromagnetic Radiation Meter (Correspondence)." 1971 Transactions on Microwave Theory and Techniques 19.2 (Feb. 1971 [T-MTT] (Special Issue on Biological Effects of Microwaves)): 249-250.

A radiation meter has been designed for the measurement of leakage from microwave ovens. A brief description of the meter is presented together with characteristics which suggest that the instrument has measurement applications other than that for which it was specifically designed. Some of the characteristics presented are geometry, temperature effects, frequency sensitivity, and conversion from calibrated power density to energy density.

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Microwave Cataract (Correspondence)

R.W. Neidlinger. "Microwave Cataract (Correspondence)." 1971 Transactions on Microwave Theory and Techniques 19.2 (Feb. 1971 [T-MTT] (Special Issue on Biological Effects of Microwaves)): 250-251.

The production of cataract by exposure to microwave radiation can occur, although just how it occurs is not well established. Clarification as to the occurrence of cataract in microwave worker population can only be achieved by careful cumulative records of the visual and ophthalmological status of microwave worker populations.

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Analeptic Effect of Microwave Irradiation on Experimental Animals (Correspondence)

R.D. McAfee. "Analeptic Effect of Microwave Irradiation on Experimental Animals (Correspondence)." 1971 Transactions on Microwave Theory and Techniques 19.2 (Feb. 1971 [T-MTT] (Special Issue on Biological Effects of Microwaves)): 251-253.

During the era of the Tri-Service Conferences, the use of X-band microwave radiation was recommended for the investigation of possible low power density "nonthermal" effects of microwave radiation on the central nervous system. The reasons for this recommendation were that 10 GHz is a widely used radar frequency, and exploratory investigations had shown that this frequency produced alterations in an animal's behavior, especially an analeptic effect; that is, the arousal of a sleeping or anesthetized animal and an increase in the alertness of an awake animal. For example, microwave irradiation to the heads of Nembutal-anesthetized animals aroused these animals from surgically-effective depths of anesthesia. The arousal response invited speculation that certain combinations of frequency, modulation, and power density could modify human performance adversely or favorably and even be of medical interest.

Abstracts

Contributors (Feb. 1971 [T-MTT])

G.E. Anderson, H.L. Bassett, L. Birenbaum, R.R. Bowman, R.L. Carpenter, H.A. Ecker, A.H. Frey, Z.R. Glaser, A.W. Guy, G.M. Heimer, H.S. Ho, R.C. Johnson, I.T. Kaplan, J.F. Lehmann, E.M. Livstone, R.F. Lutomirski, K. Marha, W. Metlay, S.M. Michaelson, L.R. Muroff, V. Popovic, S.W. Rosenthal, G.M. Samaras, H.P. Schwan, A.R. Shapiro, A.P. Sheppard, R. Sigelmann, P.F. Wacker, H.T. Yura, M.M. Zaret and R.P. Zimmer. "Contributors (Feb. 1971 [T-MTT])." 1971 Transactions on Microwave Theory and Techniques 19.2 (Feb. 1971 [T-MTT] (Special Issue on Biological Effects of Microwaves)): 253-257.

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Back Cover (Feb. 1971 [T-MTT])

"Back Cover (Feb. 1971 [T-MTT])." 1971 Transactions on Microwave Theory and Techniques 19.2 (Feb. 1971 [T-MTT] (Special Issue on Biological Effects of Microwaves)): b1-b2.

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Design of a New Broad-Band Isolator

Y. Konishi and N. Hoshino. "Design of a New Broad-Band Isolator." 1971 Transactions on Microwave Theory and Techniques 19.3 (Mar. 1971 [T-MTT]): 260-269.

The design theory and experimental results of a proposed broad-band technique of an isolator are presented. The isolator not only has a broad-band backward loss but also a low broad-band insertion loss. The network constants and the performance are obtained in connection with the magnetic loss of ferrite, and they are confirmed by experimental data. The trial ultrawide-band isolator the performance of 20-dB isolation over the frequency band from 70 MHz to 800 MHz.

Abstracts

Variable Tunneling Excitation of Optical Surface Waves

J.H. Harris and R. Shubert. "Variable Tunneling Excitation of Optical Surface Waves." 1971 Transactions on Microwave Theory and Techniques 19.3 (Mar. 1971 [T-MTT]): 269-276.

A method for coupling an optical beam into thin films utilizing shaped tunneling regions is described. It is shown that in principle all of the power can be coupled into the film. For ease of fabrication, a uniform gradient structure is preferable, however, and yields coupling of over 90 percent for incident coherent Gaussian beams. Experimental coupling values with gradient tunneling regions are in excess of 50 percent. Good mode isolation and elimination of prism edge effects are major features of the coupler. The experimental coupling values are obtained from a transmission measurement utilizing two prisms.

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Propagation Characteristics of Periodic Arrays of Dielectric Slabs

L.R. Lewis and A. Hessel. "Propagation Characteristics of Periodic Arrays of Dielectric Slabs." 1971 Transactions on Microwave Theory and Techniques 19.3 (Mar. 1971 [T-MTT]): 276-286.

Propagation along periodic arrays of dielectric slabs in the direction transverse to that of periodicity is studied as a function of the prescribed phase delay per period for two polarizations. Classification of modes is achieved with the help of "stability diagrams." In contrast with previous work, the rigorous dispersion relation and exact mode functions are considered. Calculated dispersion curves and closed form mode functions serve to illustrate the guiding properties of the structure and are, in turn, explained in terms of stability diagrams and equivalent networks.

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An Improved Interferometric Polarization Analyzer for Measuring the Microwave Magneto-Kerr Effect in Semiconductors

R.J. Vernon and T.A. Dorschner. "An Improved Interferometric Polarization Analyzer for Measuring the Microwave Magneto-Kerr Effect in Semiconductors." 1971 Transactions on Microwave Theory and Techniques 19.3 (Mar. 1971 [T-MTT]): 287-294.

An interferometric polarization analyzer for measuring the microwave magneto-Kerr effect in semiconductors is described and analyzed, and compared with earlier systems used for the same purpose. The system described utilizes a 4-port waveguide junction referred to as a dual-mode transducer (DMT). This system has important advantages over systems previously used to measure the microwave magneto-Kerr effect. Preliminary data taken with the system are presented and sources of error discussed.

Abstracts

The Design of Evanescent Mode Waveguide Bandpass Filters for a Prescribed Insertion Loss Characteristic

G.F. Craven and C.K. Mok. "The Design of Evanescent Mode Waveguide Bandpass Filters for a Prescribed Insertion Loss Characteristic." 1971 Transactions on Microwave Theory and Techniques 19.3 (Mar. 1971 [T-MTT]): 295-308.

A design theory for evanescent dominant mode waveguide filters is presented. The cutoff guide is represented by its equivalent pi-section network, the elements of which closely approximate lumped inductances. Resonators may be formed by introducing appropriate capacitive obstacles at suitable intervals along the guide. The filter that results is a microwave analog of lumped inductance filters with series inductance coupling, the magnitude of the series "inductance" being controlled by the separation between capacitive obstacles. The theory derives the equivalent ladder network from the low-pass prototype and is accurate up to at least 20 percent band-widths. Filters may be designed to couple into other cutoff waveguide components using the same basic principles, a propagating guide, and coaxial terminations. The filters are normally constructed in standard production waveguide and are simple and cheap to manufacture. A considerable size and weight reduction, compared with orthodox waveguide filters, is possible at the cost of a small increase in insertion loss.

Abstracts

Lumped Parameters of a Reentering Cylindrical Cavity

E. Rivier and M. Verge-Lapisardi. "Lumped Parameters of a Reentering Cylindrical Cavity." 1971 Transactions on Microwave Theory and Techniques 19.3 (Mar. 1971 [T-MTT]): 309-314.

The cylindrical reentering cavity is studied. It is shown how lumped equivalent parameters can be known that are one inductance and two capacitances. These elements can be measured experimentally. Thus the problem of coupling with an active solid-state element, defined itself by lumped equivalent parameters (inductances and capacitances), is accurately solved.

Abstracts

Computer Analysis of E-Plane Resonance Isolators

F.E. Gardiol and A.S. Vander Vorst. "Computer Analysis of E-Plane Resonance Isolators." 1971 Transactions on Microwave Theory and Techniques 19.3 (Mar. 1971 [T-MTT]): 315-322.

E-plane ferrite resonance isolators are commonly used in most medium-power waveguide systems, allowing to effectively decouple successive stages. The study of propagation in this type of structure leads to a set of transcendental equations, for which exact theoretical results have not been available so far. The design of these devices has been done experimentally, which is time consuming and does not allow for achievement of optimal performance due to the large number of parameters involved. The present study considers the TE/sub m0/, modes in an isolator structure. A matrix formalism is used to derive the dispersion relation, which is then solved with the help of a computer program. Experimental results for a simple structure show good agreement with the computed values. The influence of ferrite parameters on the isolation and forward losses is presented. Higher order modes in the structure and the methods to avoid them are discussed. Finally, the field distribution in the device is determined, showing a large concentration of the fields within the loading material.

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Computer Optimization of E-Plane Resonance Isolators

M.C. Decreton, E.F. Loute, A.S. Vander Vorst and F.E. Gardiol. "Computer Optimization of E-Plane Resonance Isolators." 1971 Transactions on Microwave Theory and Techniques 19.3 (Mar. 1971 [T-MTT]): 322-331.

A method has been developed to optimize the geometry of the structure and the permittivity of the dielectric material used in E-plane isolators, for an arbitrary ferrite material. The structure is first computer analyzed, using an exact analytical approach. The minimum isolation and the maximum forward attenuation per unit length are calculated within a specified frequency band. The objective function, defined as the ratio minimum isolation per maximum forward losses, is then maximized. Several optimization procedures are compared and tested; the optimum gradient method was found to be well suited to this problem. Various optimized results are presented.

Abstracts

Analysis of a Microwave Resonator-Feedback Oscillator (Correspondence)

J.R. Kim, L.C. Gunderson and J. Singletary. "Analysis of a Microwave Resonator-Feedback Oscillator (Correspondence)." 1971 Transactions on Microwave Theory and Techniques 19.3 (Mar. 1971 [T-MTT]): 331-332.

The temperature stability of the oscillation frequency, (Delta omega/omega)/Delta T, of an S-band feedback oscillator is derived in terms of the temperature stability of the stable resonator and that of the circuits external to the resonator. Conditions have been established for the optimum external circuit to achieve temperature stability of the oscillation frequency.

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Minimum Noise Figure of Paramps with Frequency Dependent Apparent R/sub s/ (Correspondence)

K. Inal and C. Toker. "Minimum Noise Figure of Paramps with Frequency Dependent Apparent R/sub s/ (Correspondence)." 1971 Transactions on Microwave Theory and Techniques 19.3 (Mar. 1971 [T-MTT]): 333-334.

The effect of inverse-squared frequency dependence of the apparent resistance of varactor diodes is discussed in the optimization of the noise figure of negative resistance and up-converter parametric amplifiers. Optimum idler frequency for a given signal frequency for minimum noise figure is calculated. It is also shown that about twofold improvement in the noise figure is obtained if the proper idler frequency is used for negative resistance amplifiers. It is also shown that the value of the optimum loading changes for upconverter amplifiers.

Abstracts

Electronically Variable Low-Dispersion YIG Delay Line (Correspondence)

R.A. Moore and G.J. Moussally. "Electronically Variable Low-Dispersion YIG Delay Line (Correspondence)." 1971 Transactions on Microwave Theory and Techniques 19.3 (Mar. 1971 [T-MTT]): 334-337.

A low dispersion YIG line was reported by Kirchner, Olson, and Bennet for which the delay was mechanically variable. A low dispersion YIG line, for which the delay is electronically variable, is described. A brief analysis is presented which determines the required magnetic field gradient needed to achieve objective dispersion characteristics. Approaches toward achieving the required field gradient are described. The resulting dispersion, almost constant and less than one-third of the typical dispersion for larger delays, is compared in detail with typical YIG line dispersion characteristics.

Abstracts

A Simple Tuning Circuit for Waveguide and Transmission Line Systems (Correspondence)

R.W. Beatty and G.H. Fentress. "A Simple Tuning Circuit for Waveguide and Transmission Line Systems (Correspondence)." 1971 Transactions on Microwave Theory and Techniques 19.3 (Mar. 1971 [T-MTT]): 337-338.

A simple tuning circuit for source or load matching is described that makes possible smooth and sensitive adjustments with no "holes" in frequency coverage over a complete waveguide band. Energy is coupled out of the mainline, the phase and magnitude adjusted with phase shifter and attenuator and fed back into the mainline to cancel the reflected signal. A simple analysis of the circuit is presented, and a graph given for estimating the maximum voltage standing-wave (VSWR) that can be "tuned out." Application to measurement of reflection coefficient or to impedance is proposed.

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Use of Symmetry in the Variational Treatment of a Magnetoplasma-Filled Waveguide (Comments)

C. Vassallo, K.S. Champlin and T. Lu. "Use of Symmetry in the Variational Treatment of a Magnetoplasma-Filled Waveguide (Comments)." 1971 Transactions on Microwave Theory and Techniques 19.3 (Mar. 1971 [T-MTT]): 338-339.

The "variational" formula established by Champlin is replaced in a general formulation of linear equations and adjoint equations. It is shown not to be stationary about the true guided fields.

Abstracts

Noise Temperature Data on Cataphoretically Pumped F13T5 Lamps (Correspondence)

R.E. Guentzler. "Noise Temperature Data on Cataphoretically Pumped F13T5 Lamps (Correspondence)." 1971 Transactions on Microwave Theory and Techniques 19.3 (Mar. 1971 [T-MTT]): 339-341.

Hg was removed from most of the positive column of an F13T5 lamp by cataphoresis; the Hg was trapped in the cathode region by cooling the bulb with ice. Noise temperatures were measured in the region of the lamp in which only an Ar discharge at 4.5 mmHg was taking place. The excess noise of the Ar discharge is given as a function of the dc discharge current from 60 to 2510 mA. An excessively large amount of noise that increased with discharge current was found to exist in the Hg portion of the discharge in the cathode region of some of the lamps. In some cases, this noise was coupled into the Ar discharge region and caused an apparent increase in the Ar noise temperature.

Abstracts

Contributors (Mar. 1971 [T-MTT])

G.F. Craven, M.C. Decreton, T.A. Dorschner, F.E. Gardiol, J.H. Harris, A. Hessel, N. Hoshino, Y. Konishi, L.R. Lewis, E.F. Loute, C.K. Mok, E. Rivier, R. Schubert , A.S. Vander Vorst, M. Verge-Lapisardi and R.J. Vernon. "Contributors (Mar. 1971 [T-MTT])." 1971 Transactions on Microwave Theory and Techniques 19.3 (Mar. 1971 [T-MTT]): 342-344.

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Information on Computer Program Descriptions (Mar. 1971 [T-MTT])

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Generalized Theory of Waveguide Differential Phase Sections and Application to Novel Ferrite Devices

N.B. Sultan. "Generalized Theory of Waveguide Differential Phase Sections and Application to Novel Ferrite Devices." 1971 Transactions on Microwave Theory and Techniques 19.4 (Apr. 1971 [T-MTT]): 348-357.

Since Fox introduced the concept of "differential phase shift" (DPS) sections in TE/sub 11/ mode cylindrical waveguide, most interest has been concentrated on devices having fixed DPS of 90° or 180°. This paper gives exact solutions for the magnitude, phase, and polarization of the wave output from three sections having variable DPS and orientations. The RF field is, successively resolved into components along the birefringence axes. Experimental results of tests carried out at X band, using a transversely magnetized ferrite tube, closely support the theory. It is shown how the latter can be applied, not only to familiar devices such as the rotary phase shifter or single sideband modulator, but also to new devices using ferrite sections of variable DPS or of switchable birefringence axes. A three-section power divider and attenuator is explained, together with a new two-section polarizer, with possible applications to satellites and search radar. It is also shown how one section can be used as a phase shifter. Some experimental results are given. Thus complete characterization of DPS section devices is offered by the theory, together with the quantitative effect of any of their parameters.

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A Study of a Driven Oscillator with FM Feedback by Use of a Phase-Lock-Loop Model

L.W. Couch. "A Study of a Driven Oscillator with FM Feedback by Use of a Phase-Lock-Loop Model." 1971 Transactions on Microwave Theory and Techniques 19.4 (Apr. 1971 [T-MTT]): 357-366.

The locking phenomenon of a driven oscillator has been studied by many authors. Huntoon and Weiss have characterized it by their locking signatures. It is also known that the difference phase of an oscillator and that of a phase-locked-loop (PLL) obey the same differential equation. In this paper a PLL configuration is obtained which yields the same locking signatures as those for the oscillator. Thus the equivalence between the oscillator and the PLL model is established both in terms of locking signature as well as in terms of frequency behavior. Since the nonlinear equations describing the oscillator and PLL model are identical, any static or dynamic results which apply to one also apply to the other. In systems containing oscillators, each oscillator maybe replaced by its equivalent PLL model so that the system may be analyzed more easily. For example, the locking-signature shape and the locking bandwidth of two coupled oscillators are given in terms of parameters which are easy to measure. In a second example, results are presented which describe the performance of an oscillator which is frequency modulated by a feedback signal. It is found that the signature shape and locking bandwidth may be set to any desired value by the proper choice of feedback parameters. Experimental results are presented which verify the theoretical results.

Abstracts

Broad-Banding and Changing Operation Frequency of Circulator

Y. Naito and N. Tanaka. "Broad-Banding and Changing Operation Frequency of Circulator." 1971 Transactions on Microwave Theory and Techniques 19.4 (Apr. 1971 [T-MTT]): 367-372.

Broad-banding of a circulator and changing of operation frequency of a lumped-element circulator are discussed. The point of broad-banding is to represent the circulator in a distributed element equivalent circuit. The improvement of the relative bandwidth was between 10 and 20 percent. The point of changing of operation frequency is to use a variable capacitance diode instead of a fixed one. The result is that the operating frequency changed from 120 to 220 MHz with a bias voltage change from 2 to 10 V.

Abstracts

Coaxial Bandpass Filter Design

W.A. Davis and P.J. Khan. "Coaxial Bandpass Filter Design." 1971 Transactions on Microwave Theory and Techniques 19.4 (Apr. 1971 [T-MTT]): 373-380.

A technique is described for synthesis of coaxial bandpass filters based on an improved design of impedance inverters. This technique is applicable to filters having bandwidths between approximately 1 percent and 20 percent of the center frequency. The inverter used to realize the filters is a section of either low-Z/sub 0/ line or high-Z/sub 0/ line and is synthesized as a distributed element rather than as a lumped shunt capacitance or lumped series inductance, respectively. Three methods of accommodating the discontinuity capacitance associated with an abrupt change in the characteristic impedance are reviewed. The first two methods are most useful for filters with a fractional bandwidth/spl gsim/ 10 percent and the third for a fractional bandwidths /spl lsim/10 percent. Numerical and experimental verification of the design procedure is provided.

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Tables of Impedance Matching Networks Which Approximate Prescribed Attenuation Versus Frequency Slopes

O. Pitzalis, Jr. and R.A. Gilson. "Tables of Impedance Matching Networks Which Approximate Prescribed Attenuation Versus Frequency Slopes." 1971 Transactions on Microwave Theory and Techniques 19.4 (Apr. 1971 [T-MTT]): 381-386.

Tables of normalized lumped lossless two-section impedance matching networks, which closely approximate -4, -5, and -6 dB per octave attenuation versus frequency characteristics are provided. Impedance transformation ratios vary from 20:1 to 100:1. Bandwidths range from 30 to 67 percent. The networks are particularly suited to broad-banding of RF power transistor stages. Measured performance of a 12-W, 225-400-MHz transistor stage illustrates application of the designs.

Abstracts

Modal Inversion in Circular Waveguides -- Part I: Theory and Phenomenology

G.N. Tsandoulas and W.J. Ince. "Modal Inversion in Circular Waveguides -- Part I: Theory and Phenomenology." 1971 Transactions on Microwave Theory and Techniques 19.4 (Apr. 1971 [T-MTT]): 386-392.

Part I of this work investigates the phenomenon of mode reordering in circular waveguides containing one or more dielectrics. Specifically, conditions are established, be they ranges of dimensions, dielectric constants, or frequency, under which the sequence, TM/sub 01/, TE/sub 01/, TE/sub 11/, and TE/sub 21/ is obtained instead of the conventional TE/sub 11/, TM/sub 01/, TE/sub 21/, and TE/sub 01/. The desired effect is the reversal of the order of propagation between the normally dominant TE/sub 11/ mode and the circularly symmetric low-loss TE/sub 01/. Bandwidth regimes are drawn and the credibility of the dielectric model is examined and found to be satisfactory for the application of the phenomenon to the design of digital ferrite phase shifters operating in the TE/sub 01/ mode.

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Modal Inversion in Circular Waveguides -- Part II: Application to Latching Nonreciprocal Phasers

W.J. Ince and G.N. Tsandoulas. "Modal Inversion in Circular Waveguides -- Part II: Application to Latching Nonreciprocal Phasers." 1971 Transactions on Microwave Theory and Techniques 19.4 (Apr. 1971 [T-MTT]): 393-400.

The characteristics of the nonreciprocal phase shifter (phaser) configuration, consisting of a circumferentially magnetized circular toroid in circular waveguide, have been investigated theoretically. By suitably filling the toroid center with a material having a high dielectric constant, it is possible to reverse the normal order of the cutoff frequencies of the TE/sub 11/ and the operating TE/sub 01/ modes. The enhanced modal purity resulting from this inversion could yield significant improvements in the performance of practical phasers. The characteristic equation has been derived for the general case of a magnetized toroid in a circular waveguide, with dielectric material in both the central region and external to the toroid. The equation is valid for an arbitrary range of dielectric constants and magnetization. Differential phase shift calculations have been made specifically for operation within the modal inversion window. It is found that adequate differential phase shifts are obtained, even under the restrictions on geometric dimensions and range of dielectric constants imposed by the inversion requirements.

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Dispersion Relations for Guided Waves in a Simple Moving Medium (Correspondence)

H.Y. Yee. "Dispersion Relations for Guided Waves in a Simple Moving Medium (Correspondence)." 1971 Transactions on Microwave Theory and Techniques 19.4 (Apr. 1971 [T-MTT]): 400-401.

The relations between the propagation constant and the frequency are derived for a waveguide filled with a simple moving medium. A set of dispersion curves is presented and some interesting propagation properties are derived from these dispersion curves.

Abstracts

Mode Propagation in a Nonuniform Cylindrical Medium (Correspondence)

A.W. Snyder. "Mode Propagation in a Nonuniform Cylindrical Medium (Correspondence)." 1971 Transactions on Microwave Theory and Techniques 19.4 (Apr. 1971 [T-MTT]): 402-403.

A simplified form of the coupling coefficient C(beta/sub p/, beta/sub q/) resulting from a coupled mode theory analysis of wave propagation in a nonuniform medium is derived. It is found for most situations of interest that C(beta/sub p/, beta/sub q/) is proportional to 1/(beta/sub p/- beta/sub q/) and the power transfer between two modes is proportional to 1/(beta/sub p/-beta/sub q/)/sup 4//spl dot/ beta/sub p/ and beta/sub q/ are the two different modal propagation constants. For a dielectric rod C(/spl beta//sub p/, /spl beta//sub q/) is a simple line integral around the rod boundary. Approximate forms are presented for optical waveguides.

Abstracts

A Laser Resonator with a Selector for a Higher Transverse Mode (Correspondence)

S. Kawakami and S. Nishida. "A Laser Resonator with a Selector for a Higher Transverse Mode (Correspondence)." 1971 Transactions on Microwave Theory and Techniques 19.4 (Apr. 1971 [T-MTT]): 403-406.

A new laser resonator is proposed in which a specified higher order Hermite-Gaussian mode becomes the lowest loss mode. The two reflectors in the resonator are blocked in the vicinity of the characteristic zeros of the mode and the edge (i.e., |x|, |y| --> /spl infin/). In such a configuration the mode volume is enhanced, and mode selection is improved as compared with a conventional resonator in which a Gaussian mode is the dominant one. We have specialized to TEM/sub 22/ mode. The solutions to the integral equation for the eigenmodes and eigenvalues of the resonator are obtained on a digital computer. The computed eigenfunctions and mode selection show several interesting characteristics, and the loss mechanism for a few low-loss modes are elucidated. The computational results show that the location and the width of the blocking structure are closely related to the mode competition phenomenon and therefore mode selection.

Abstracts

A Technique for Measuring Phase at Millimeter Wavelengths (Correspondence)

F.H. Cleveland and N.P. Kernweis. "A Technique for Measuring Phase at Millimeter Wavelengths (Correspondence)." 1971 Transactions on Microwave Theory and Techniques 19.4 (Apr. 1971 [T-MTT]): 406-410.

A technique for measuring the phase of millimeter signals in free space is described that uses a reference signal of varying phase. The phase of the reference signal is measured independently and subtracted from the total phase measured to determine the desired phase. The use of a varying reference phase is necessary because flexible or movable waveguide whose phase characteristics can readily be measured are not available at millimeter wavelengths. The theory of the technique described is based upon the interference pattern of slowly varying electric fields.

Abstracts

Roots of Equiripple Insertion-Loss Functions for Commensurate Line Filters

O.P. Gupta. "Roots of Equiripple Insertion-Loss Functions for Commensurate Line Filters." 1971 Transactions on Microwave Theory and Techniques 19.4 (Apr. 1971 [T-MTT]): 410-411.

A technique is presented to find the roots of low-pass equiripple insertion-loss functions realizable by commensurate line filters containing stubs as well as the unit elements. The technique is akin to closed form solution in that the roundoff errors of one root do not affect the rest of the roots. Results of a numerical example illustrate the practical advantage of this technique.

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International Intercomparison of Power Standards at 3 GHz (Correspondence)

G.F. Engen and P.A. Hudson. "International Intercomparison of Power Standards at 3 GHz (Correspondence)." 1971 Transactions on Microwave Theory and Techniques 19.4 (Apr. 1971 [T-MTT]): 411-413.

An international intercomparison of microwave power at 3 GHz has recently been completed. This comparison was initiated at a meeting of the High Frequency Working Group of the Comite Consultatif d'Electricite (CCE) which met at the Bureau International des Poids et Measures (BIPM) in May, 1965. At that time, the U.S. National Bureau of Standards (NBS) was designated as the pilot laboratory. The other laboratories, in the order of their participation, are the following: for Canada, National Research Council (NRC); for the U.S.S.R., All-Union Research Institute of Metrology imeni D. I. Mendeleyev (VNIIM); for the German Democratic Republic, Deutsches Amt fur Messwesen und Warenprufung (DAMW); and for Japan, the Electrotechnical Laboratory (ETL).

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Complex Permittivity of Conductor-Dielectric Mixtures (Correspondence)

W.S. Rothwell. "Complex Permittivity of Conductor-Dielectric Mixtures (Correspondence)." 1971 Transactions on Microwave Theory and Techniques 19.4 (Apr. 1971 [T-MTT]): 413-415.

Solutions of currently available theories for the permittivity of mixtures are used to show the concentration dependence of real and imaginary parts of the complex permittivity. Results are shown for spherical conducting particles in a pure dielectric host medium and are compared with available experimental data.

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Tensor Character of Symmetrical Waveguide Junctions (Correspondence)

J.B. Knorr. "Tensor Character of Symmetrical Waveguide Junctions (Correspondence)." 1971 Transactions on Microwave Theory and Techniques 19.4 (Apr. 1971 [T-MTT]): 414-415.

The elements of the scattering matrix of a symmetrical waveguide junction are shown to transform in such a way that they may be treated as a tensorial set. When properly arranged, these elements carry the direct product representation {D(R) X D(R)} of the symmetry group of the junction. The number of independent elements in the scattering matrix is then determined by the number of times that the identity representation is contained in the direct product representation.

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On the Design of Impedance-Transforming Directional Couplers (Correspondence)

R.B. Ekinge. "On the Design of Impedance-Transforming Directional Couplers (Correspondence)." 1971 Transactions on Microwave Theory and Techniques 19.4 (Apr. 1971 [T-MTT]): 415-416.

It is shown that if impedance-transforming couplers are allowed to be mismatched it is possible to analyze them by using an even-odd-mode method and design them just like ordinary directional couplers.

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Differences Between In-Line and Crossed-Field Three-Port Circuit Models for Interdigital Transducers (Correspondence)

W.R. Smith and H.M. Gerard. "Differences Between In-Line and Crossed-Field Three-Port Circuit Models for Interdigital Transducers (Correspondence)." 1971 Transactions on Microwave Theory and Techniques 19.4 (Apr. 1971 [T-MTT]): 416-417.

Specific comparisons are given which emphasize the similarities and differences between two previously published circuit models for the interdigital surface-wave transducer. It is shown that the choice between the two models depends on the piezoelectric substrate used.

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MSTRIP (Parameters of Microstrip) (Computer Program Descriptions)

T.G. Bryant and J.A. Weiss. "MSTRIP (Parameters of Microstrip) (Computer Program Descriptions)." 1971 Transactions on Microwave Theory and Techniques 19.4 (Apr. 1971 [T-MTT]): 418-418.

This program calculates the characteristic impedance, phase velocity, and effective dielectric constant of single or coupled microstrip lines. Parameters to be specified by the user are as follows: range of W/H/sub 1/, S/H/sub 1/, substrate dielectric constant, single or coupled lines with or without an upper ground plane.

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L.W. Couch, W.A. Davis, R.A. Gilson, W.J. Ince, P.J. Khan, Y. Naito, O. Pitzalis, Jr., N.B. Sultan, N. Tanaka and G.N. Tsandoulas. "Contributors (Apr. 1971 [T-MTT])." 1971 Transactions on Microwave Theory and Techniques 19.4 (Apr. 1971 [T-MTT]): 419-420.

Abstracts

Information on Computer Program Descriptions (Apr. 1971 [T-MTT])

"Information on Computer Program Descriptions (Apr. 1971 [T-MTT])." 1971 Transactions on Microwave Theory and Techniques 19.4 (Apr. 1971 [T-MTT]): 421-422.

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The Even- and Odd-Mode Capacitance Parameters for Coupled Lines in Suspended Substrate (May 1971 [T-MTT])

J.I. Smith. "The Even- and Odd-Mode Capacitance Parameters for Coupled Lines in Suspended Substrate (May 1971 [T-MTT])." 1971 Transactions on Microwave Theory and Techniques 19.5 (May 1971 [T-MTT]): 424-431.

Static capacitance characterizations are derived for coupled thin-film conductors in the suspended substrate geometry, which includes shielded microstrip as a special case. In particular, a satisfactory treatment of closely coupled and narrow lines is obtained where, because of the dominance of the edge singularity, "mesh point" analyses are inadequate. The present work was carried through to meet the need in interactive design procedures for characterization of a general transmission geometry. For these procedures, algorithms are required that take little storage and are suitable for very rapid calculations. Capacitance formulas are derived from variational series based on conformal transformations, and these series are converted to easily evaluated finite forms. Calculation of the even- and odd-mode fringing capacitances for coupled limes is made for finite line widths assuming a periodic array of lines. The applicability of these capacitances to a single pair of lines and to finite filter arrays has been checked experimentally. Routines for lower bound values of fringing capacitances are given. Upper bound formulations validate the accuracy of the lower bound calculations.

Abstracts

A Design Method for Meander-Line Networks Using Equivalent Circuit Transformations

R. Sato. "A Design Method for Meander-Line Networks Using Equivalent Circuit Transformations." 1971 Transactions on Microwave Theory and Techniques 19.5 (May 1971 [T-MTT]): 431-442.

Many types of coupled structures are used to design microwave filters and equalizers. One such structure is the array of coupled parallel commensurate conductors called a meander line. There are several analysis techniques that may be used to find the equivalent circuit of a meander line. However, these do not provide exact design equations. In this paper, meander-line networks are analyzed and synthesized using the graph-transformation technique. The equivalent circuits of one- and two-port meander-line networks will be developed by using the transformation method, and it will be shown that meander-line networks can be easily designed by using the electronic computer.

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Abstracts

Reciprocal and Nonreciprocal Modes of Propagation in Ferrite Stripline and Microstrip Devices

M.E. Hines. "Reciprocal and Nonreciprocal Modes of Propagation in Ferrite Stripline and Microstrip Devices." 1971 Transactions on Microwave Theory and Techniques 19.5 (May 1971 [T-MTT]): 442-451.

An approximate analysis is presented together with a physical description of the modes of propagation in stripline and microstrip devices of significant width, using ferrite slabs as dielectric material, magnetized perpendicular to the ground plane. The dominant mode resembles TEM propagation, except that there is a strong transverse field displacement, causing wave energy to be concentrated along one edge of the line. Nonreciprocal behavior is obtainable by asymmetrically loading the edges. Approximate analytical techniques are given for isolators and phase shifters, with examples of numerical computations and experimental results.

Abstracts

On the Design of Optimum Dual-Series Feed Networks

W.R. Jones and E.C. DuFort. "On the Design of Optimum Dual-Series Feed Networks." 1971 Transactions on Microwave Theory and Techniques 19.5 (May 1971 [T-MTT]): 451-458.

A computer-implemented procedure is presented for the design of optimally efficient dual-series feed networks for use in waveguide phased arrays where the network directional couplers are limited in their values of maximum coupling by geometrical and bandwidth requirements. The theory of the design procedure is outlined and results for the design of sum and difference pattern element excitations for typical coupler limitations are presented.

Abstracts

Field Description with Spatial Complex Variables and its Application to Scattering and Waveguide Problems

M. Hashimoto and K. Fujisawa. "Field Description with Spatial Complex Variables and its Application to Scattering and Waveguide Problems." 1971 Transactions on Microwave Theory and Techniques 19.5 (May 1971 [T-MTT]): 458-474.

The field description with spatial complex variables is proposed. The complex variables z, z/spl overbar/ are chosen, where z= x+iy and z/spl overbar/ is the complex conjugate. A contour integral in a complex plane is and the residue theorem is applied. The variables are changed by a transforming (mapping) function. The field description is applied to the boundary-value problems with arbitrary boundary. An approximate method is developed throughout this paper. It is pointed out that the integration can be performed easily and our analytical effort can be reduced. The two-dimensional scattered fields in free space from the perfectly conducting obstacle with arbitrary cross section are solved under assumption of small size. Furthermore the method is applied to the scattered fields in the rectangular waveguide with an inductive post or a capacitive post. The transmission coefficient and the reflection coefficient are obtained in the general forms which involve the boundary parameters indicating the shape of the boundary.

Abstracts

Diffraction of Electromagnetic Waves by a Conducting Screen Perforated Periodically with Circular Holes

C.-C. Chen. "Diffraction of Electromagnetic Waves by a Conducting Screen Perforated Periodically with Circular Holes." 1971 Transactions on Microwave Theory and Techniques 19.5 (May 1971 [T-MTT]): 475-481.

The reflection and transmission of a plane wave incident on a thin perfectly conducting screen perforated periodically with circular holes are considered. The spacings between holes may be comparable to or less than the wavelength. The metal screen is assumed to be either backed by a flat dielectric sheet, or sandwiched between two or more dielectric sheets that are used to match the susceptsnce of the screen. The techniques of transmission line analysis and the method of moments are employed to obtain a solution for this general class of boundary-value problems. Numerical results for several cases of interest in both X and Ku bands were obtained and shown to be in good agreement with experimental measurements.

Abstracts

Noise Figure for a Mixer Diode (Correspondence)

J.W. Gewartowski. "Noise Figure for a Mixer Diode (Correspondence)." 1971 Transactions on Microwave Theory and Techniques 19.5 (May 1971 [T-MTT]): 481-481.

Equations are presented for the noise figure of a mixer using a resistive diode. These results are more general than those presented previously by Barber.

Abstracts

Two-Cavity Ring-Type Channel-Dropping Filters for a Millimeter-Wave Guided Wave Communication System (Correspondence)

I. Ootomo, S. Shimada and N. Suzuki. "Two-Cavity Ring-Type Channel-Dropping Filters for a Millimeter-Wave Guided Wave Communication System (Correspondence)." 1971 Transactions on Microwave Theory and Techniques 19.5 (May 1971 [T-MTT]): 481-484.

Newly developed two-cavity ring-type filters for a millmeter-wave communication system are described. They are used in a five-channel transmit and receive multiplexer which operates in the 50-GHz frequency band. The pulse response and interchannel crosstalk characteristics for 250-Mbit PCM-AM or PCM-PSK transmission were calculated and compared with experimental results.

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Use of Finite Difference Approximations to Partial Differential Equations for Problems Having Boundaries at Infinity (Correspondence)

F. Sandy and J. Sage. "Use of Finite Difference Approximations to Partial Differential Equations for Problems Having Boundaries at Infinity (Correspondence)." 1971 Transactions on Microwave Theory and Techniques 19.5 (May 1971 [T-MTT]): 484-486.

A computationally simple technique is presented for solving finite difference equations arising from potential problems, part of whose boundary is at infinity. The procedure makes use of an arbitrary "fictitious" boundary drawn close to the regions of physical interest. An initial guess is made of the potential on this boundary as well as at all interior points. Well-known iterative techniques are used to correct the values of the interior potentials. Meanwhile the potentials on the boundary are corrected iteratively by recalculating them from the sources or charges in the entire region, which in turn are calculated from the current iteration of the interior potential. The technique is valid even if parts of the physical structure, such as an air-dielectric interface in microstrip, extend toward infinity. The fictitious boundary need not include all of the structure, providing the rate of falloff of the sources outside the boundary is known.

Abstracts

New Design Equations for a Class of Microwave Filters (Correspondence)

E.G. Cristal. "New Design Equations for a Class of Microwave Filters (Correspondence)." 1971 Transactions on Microwave Theory and Techniques 19.5 (May 1971 [T-MTT]): 486-490.

New approximate design equations for a class of microwave bandpass filters are presented. The filters are 1) dual forms of half-wave parallel-coupled resonator filters, 2) one form of interdigital filter, and 3) dual forms of direct-coupled stub filters. The advantages derived from using the new equations are 1) exact realization of the specified design bandwidth and 2) improved pass-band voltage standing-wave ratio (VSWR) response in the vicinity of band edge. Experiments data are presented for a trial filter design having 7 resonators, 40-percent bandwidth, and passband VSWR of 1.2.

Abstracts

Some Considerations about the Diffraction Loss of Open Resonators (Correspondence)

G.R. Bisio, L. Ronchi and V. Tognetti. "Some Considerations about the Diffraction Loss of Open Resonators (Correspondence)." 1971 Transactions on Microwave Theory and Techniques 19.5 (May 1971 [T-MTT]): 490-491.

The concept of "effective" number of Fresnel zones is used in order to discuss some properties of the losses of the open resonators, as functions of the resonator geometry. The cases of the flat-roof resonator and the step-rim resonator are discussed in detail.

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Integrated Parametric Amplifier Module with Self-Contained Solid-State Pump Source (Correspondence)

H.C. Okean, C.M. Allen, E.W. Sard and H. Weingart. "Integrated Parametric Amplifier Module with Self-Contained Solid-State Pump Source (Correspondence)." 1971 Transactions on Microwave Theory and Techniques 19.5 (May 1971 [T-MTT]): 491-493.

Three completely integrated S-band parametric amplifier modules, of a type ultimately suitable for spaceflight applications, have been constructed and tested. Each consists of a single-stage thin-film-microstrip 2.25-GHz parametric amplifier, closely integrated with a waveguide-mounted isolator-coupled 14-GHz Gunn-effect pump oscillator in a 6-in aluminum housing weighing less than 0.6 lb. The pertinent measured characteristics of the three modules include: 2.25-GHz center frequency, 15-dB maximum gain, 76-90-MHz 1-dB bandwidth, and 139-170° K passband temperature.

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Abstracts

Performance Limitations of Lossy Circulators (Correspondence)

H. Bex and E. Schwartz. "Performance Limitations of Lossy Circulators (Correspondence)." 1971 Transactions on Microwave Theory and Techniques 19.5 (May 1971 [T-MTT]): 493-494.

For lossy circulators which are not too far from the ideal circulator important necessary inequalities for the insertion loss which constitute interesting performance limitations are derived approximately. The case of semi-ideal circulators is discussed briefly and the validity of the approximations is estimated.

Abstracts

Computation of Lumped Microstrip Capacities by Matrix Methods---Rectangular Sections and End Effect (Correspondence)

A. Farrar and A.T. Adams. "Computation of Lumped Microstrip Capacities by Matrix Methods---Rectangular Sections and End Effect (Correspondence)." 1971 Transactions on Microwave Theory and Techniques 19.5 (May 1971 [T-MTT]): 495-497.

The method of moments is applied to three-dimensional microstrip problems to calculate lumped (or excess) capacitance. As examples, the capacitance of open-circuited microstrip lines and the capacitance of rectangular microstrip sections are computed. The open-circuit data are basic to any three-dimensional problem. The method is a general one and can be used to compute the lumped capacitance of any microstrip discontinuity, such as bends and T junctions.

Abstracts

A Time-Delay Equalizer Using Directional Filter Cascades (Correspondence)

R.D. Standley. "A Time-Delay Equalizer Using Directional Filter Cascades (Correspondence)." 1971 Transactions on Microwave Theory and Techniques 19.5 (May 1971 [T-MTT]): 497-498.

In the millimeter-wave waveguide system considered for long-distance communication, the dispersive nature of the circular electric TE/sub 01/ mode can produce severe pulse distortion. To correct this problem, equalization of the guide delay distortion characteristic at the intermediate frequency is being considered. This correspondence shows that directional filter cascades are, in theory, capable of performing the required function.

Abstracts

Contributors (May 1971 [T-MTT])

C.-C. Chen, E.C. DuFort, K. Fujisawa, M. Hashimoto, M.E. Hines, W.R. Jones, R. Sato and J.I. Smith. "Contributors (May 1971 [T-MTT])." 1971 Transactions on Microwave Theory and Techniques 19.5 (May 1971 [T-MTT]): 498-499.

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"Membership Application (May 1971 [T-MTT])." 1971 Transactions on Microwave Theory and Techniques 19.5 (May 1971 [T-MTT]): 501-501.

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Numerical Solution of Dielectric Loaded Waveguides: II--Modal Approximation Technique

Z.J. Csendes and P. Silvester. "Numerical Solution of Dielectric Loaded Waveguides: II--Modal Approximation Technique." 1971 Transactions on Microwave Theory and Techniques 19.6 (Jun. 1971 [T-MTT]): 504-509.

A numerical method is described for the solution of the electromagnetic fields in dielectric loaded waveguides. The method uses the cutoff modes of the waveguide, obtained by finite-element analysis, to determine by matrix methods the fields above cutoff. A theoretical comparison with the conventional finite-element method is given and a general, highly efficient computer program for the analysis of dielectric loaded waveguides by the new method is described. Dispersion curves and contour plots obtained from the program are shown for several geometrical configurations, and these results are compared with analytic values and those obtained by the conventional finite-element method.

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A 35-GHz Isolator Using a Coaxial Solid-State Plasma in a Longitudinal Magnetic Field

B.R. McLeod and W.G. May. "A 35-GHz Isolator Using a Coaxial Solid-State Plasma in a Longitudinal Magnetic Field." 1971 Transactions on Microwave Theory and Techniques 19.6 (Jun. 1971 [T-MTT]): 510-516.

The device considered in this study is a semiconductor isolator consisting of a circular waveguide with a cylindrical rod of n-type InSb mounted coaxially in the guide. To achieve nonreciprocal operation, the InSb was cooled to liquid nitrogen temperature, a dc magnetic field was applied parallel to the direction of propagation, and a circularly polarized signal was used to excite the waveguide containing the rod. The pertinent solution of Maxwell's equations was programmed for a digital computer to allow numerical evaluation of the characteristics of the isolator using an InSb rod in which losses were present. Experimental data for various parameters and the corresponding calculated data are presented and compared. Low forward loss is achieved with the present coaxial geometry because of strong power concentration effects within or outside of the InSb rod as a function of the direction of propagation. Two series of calculated mode patterns are presented that demonstrate two types of operation of the isolator in achieving a high loss for one direction of propagation, one depending on field displacement, the other on mode coupling. These data are again compared to the experimental evidence.

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Determination of Complex Permittivity of Arbitrarily Dimensioned Dielectric Modules at Microwave Frequencies

W. Rueggeberg. "Determination of Complex Permittivity of Arbitrarily Dimensioned Dielectric Modules at Microwave Frequencies." 1971 Transactions on Microwave Theory and Techniques 19.6 (Jun. 1971 [T-MTT]): 517-521.

A method of evaluating the microwave dielectric properties of any geometrically defined sample is described by general theory and through experimental verification. The typical mathematical relations that describe specimen loss tangent by cavity methods are uniquely modified through inclusion of the derivative of cavity resonant frequency with respect to dielectric constant of the material comprising the particular configuration studied. The dielectric modules under study need not meet the small volume requirements demanded by perturbation theory; they may even occupy a very large volume of the cavity. A particular advantage of the described evaluation technique is the continuity of use of a given dielectric specimen for tests at microwave frequencies, without geometric alteration, after its properties at lower frequencies have been determined.

Abstracts

Scattering by a Ferrimagnetic Circular Cylinder in a Rectangular Waveguide

N. Okamoto, I. Nishioka and Y. Nakanishi. "Scattering by a Ferrimagnetic Circular Cylinder in a Rectangular Waveguide." 1971 Transactions on Microwave Theory and Techniques 19.6 (Jun. 1971 [T-MTT]): 521-527.

A general and rigorous formulation of the scattering by a dc magnetized ferrimagnetic cylinder in a rectangular waveguide is derived. This formulation leads to an approximate solution whose error can be quantitatively estimated. As an example, the case in which the ferrimagnetic cylinder is centrally placed is solved. It is shown that previously existing approximate solutions are not valid for the resonant situation in view of their accuracy.

Abstracts

Convergence of Numerical Solutions of Iris-Type Discontinuity Problems

S.W. Lee, W.R. Jones and J.J. Campbell. "Convergence of Numerical Solutions of Iris-Type Discontinuity Problems." 1971 Transactions on Microwave Theory and Techniques 19.6 (Jun. 1971 [T-MTT]): 528-536.

The convergence of numerical solutions of several iris-type discontinuity problems in waveguides and periodic structures is investigated. It is demonstrated that the numerical solution of a set of equations obtained from a mode-matching procedure (which corresponds to an integral equation formulation of the problem generally known as the moment method) may converge to an incorrect value if an improper ratio is chosen between the number of modal terms in the aperture and the number of terms retained in the kernel of the integral equation. Guidelines for efficient numerical computations are indicated.

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Characteristics of Propagating Waves on Yagi-Uda Structure

L.C. Shen. "Characteristics of Propagating Waves on Yagi-Uda Structure." 1971 Transactions on Microwave Theory and Techniques 19.6 (Jun. 1971 [T-MTT]): 536-542.

Analytic solutions of the current distribution, the k-beta diagram, and the cutoff frequencies are obtained for electromagnetic waves propagating on an infinite Yagi-Uda structure. All quantities are expressed in terms of tabulated functions without involving numerical integrations. Theoretical limits of various passbands are also calculated.

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Note on the Inversion of the Schwarz-Christoffel Conformal Transformation

L. Lewin. "Note on the Inversion of the Schwarz-Christoffel Conformal Transformation." 1971 Transactions on Microwave Theory and Techniques 19.6 (Jun. 1971 [T-MTT]): 542-546.

An inversion procedure, based on the methods used in proving Burmann's theorem, is used to provide an integral expression which exhibits the form of the electrostatic field explicitly in terms of the field coordinates. The method is illustrated with an example of a stepped-guide junction. The form of the field and the expression for the mode expansion coefficients are examined. The results are related to the companion problem of solving for the transverse field from a singular integral equation formulation. The two methods agree in the particular case of a two-to-one step for which special simplifications are possible. In the general case, progress in the solution of a class of double-kernel integral equations may be expected through the indirect use of the inversion of the solution obtained from the conformal transformation methods.

Abstracts

On the Complete Eigenvalue Solution of Ridged Waveguide

J.P. Montgomery. "On the Complete Eigenvalue Solution of Ridged Waveguide." 1971 Transactions on Microwave Theory and Techniques 19.6 (Jun. 1971 [T-MTT]): 547-555.

The complete solution of the ridged waveguide eigen-value problem is presented. The solution is obtained by the formulation of an integral eigenvalue equation which is subsequently solved numerically by application of the Ritz-Galerkin method. The significance of the eigenvalue spectrum is discussed and the modes are classified as either hybrid or trough modes. Equations are given for the electric and magnetic fields and a brief discussion of the edge singularity is presented. The theory is illustrated by computing the dominant eigenvalues and characteristic impedances of various unsymmetrical ridged waveguides.

Abstracts

Millimeter Wave Power Transmission and Reflection in Semiconductor Image-Converting Systems (Correspondence)

R. Mavaddat. "Millimeter Wave Power Transmission and Reflection in Semiconductor Image-Converting Systems (Correspondence)." 1971 Transactions on Microwave Theory and Techniques 19.6 (Jun. 1971 [T-MTT]): 555-558.

Power transmitted or reflected at millimeter wave-lengths in image-converting systems using a semiconductor illuminated panel is determined. The panel assembly response is defined and evaluated for two modes of operation. In the reflection mode both the cases of uniform circular light illumination and laser beam illumination of the semiconductor material are considered. In the transmission mode of operation the panel is assumed to be uniformly illuminated apart from a circular shadow region. The effect of recombination velocity at the surface of the semiconductor panel is determined.

Abstracts

400-MHz Acoustic Surface-Wave Pulse Expansion and Compression Filter (Correspondence)

C.L. Grasse and D.A. Gandolfo. "400-MHz Acoustic Surface-Wave Pulse Expansion and Compression Filter (Correspondence)." 1971 Transactions on Microwave Theory and Techniques 19.6 (Jun. 1971 [T-MTT]): 558-559.

An acoustic surface-wave device capable of both the generation and compression of a linear FM waveform has been developed. The device has a synchronous frequency of 400 MHz, a dispersive bandwidth of 80 MHz, and achieved a pulse compression ratio of 25:1. The uncompressed pulsewidth is 0.5 µs.

Abstracts

Foreshortening of Microstrip Open Circuits on Alumina Substrates (Correspondence)

L.S. Napoli and J.J. Hughes. "Foreshortening of Microstrip Open Circuits on Alumina Substrates (Correspondence)." 1971 Transactions on Microwave Theory and Techniques 19.6 (Jun. 1971 [T-MTT]): 559-561.

One particular discontinuity encountered in microstrip circuitry, the end effect of microstrip lines, is discussed. Experimental data of the end effect of 10 microstrip lines are plotted and compared with previously published data. Results reported here are consistent with that which is known about the edge effect of uniform microstrip transmission lines.

Abstracts

On High-Power Circulators with Mismatched Terminations (Correspondence)

F.E. Gardiol. "On High-Power Circulators with Mismatched Terminations (Correspondence)." 1971 Transactions on Microwave Theory and Techniques 19.6 (Jun. 1971 [T-MTT]): 561-562.

A comparison of the signal level in the ferrite-loaded sections of high-power circulators shows that the advantage presented by the coupled-line approach decreases when the device is terminated into a mismatch.

Abstracts

A Note on the Dielectric-Filled Waveguide as a Delay Line for Pulse Compression (Correspondence)

B. Minakovic. "A Note on the Dielectric-Filled Waveguide as a Delay Line for Pulse Compression (Correspondence)." 1971 Transactions on Microwave Theory and Techniques 19.6 (Jun. 1971 [T-MTT]): 562-563.

For equal group delays, bandwidth, and frequency, a dielectric-filled waveguide is always lossier than an empty one, even if the dielectric is lossless.

Abstracts

Toroid Corner Chamfering as a Method of Improving the Figure of Merit of Latching Ferrite Phasers (Correspondence)

W.J. Ince, D.H. Temme and F.G. Willwerth. "Toroid Corner Chamfering as a Method of Improving the Figure of Merit of Latching Ferrite Phasers (Correspondence)." 1971 Transactions on Microwave Theory and Techniques 19.6 (Jun. 1971 [T-MTT]): 563-564.

Corner chamfering of latching phaser toroids has been investigated. It is shown that the resulting increase in differential phase shift is a function of the dielectric loading of the toroid slot.

Abstracts

Contributors (Jun. 1971 [T-MTT])

J.J. Campbell, Z.J. Csendes, W.R. Jones, S.-W. Lee, L. Lewin, W.G. May, B.R. McLeod, J.P. Montgomery, Y. Nakanishi, I. Nishioka, N. Okamoto, W. Rueggeberg, L.-C. Shen and P. Silvester. "Contributors (Jun. 1971 [T-MTT])." 1971 Transactions on Microwave Theory and Techniques 19.6 (Jun. 1971 [T-MTT]): 565-566.

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Microwave Abstracts (Jun. 1971 [T-MTT])

"Microwave Abstracts (Jun. 1971 [T-MTT])." 1971 Transactions on Microwave Theory and Techniques 19.6 (Jun. 1971 [T-MTT]): 567-568.

Based on technical merit and timeliness, microwave papers in journals published outside the United States have been selected and compiled below, generally with brief abstracts. Reprints of the papers maybe obtained by writing directly to the author or to the source quoted.

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Introductory Remarks (Jul. 1971 [T-MTT])

J.B. Horton. "Introductory Remarks (Jul. 1971 [T-MTT])." 1971 Transactions on Microwave Theory and Techniques 19.7 (Jul. 1971 [T-MTT] (Special Issue on Microwave Integrated Circuits)): 569-569.

The technology of microwave integrated circuits has continued to be one of the major forefronts in microwave technology in recent years. Since the inception of microwave integrated circuits in 1964, work on many development programs has provided new devices and techniques that have resulted in a constantly changing technology. Early trends showed that the monolithic fabrication technique, fabricating devices and circuits on a single semiconductor substrate, has an advantage in economy if large quantities of circuits are produced. In the applications that followed, however, these large quantities did not materialize in microwave work and most workers have turned to hybrid techniques using low-loss nonsemiconducting sub-strates on which passive elements could be fabricated, with active devices being attached after fabrication of the circuit was completed. Recent developments in lumped element technology have resulted in even further trends toward hybrid fabrication techniques that involve the use of the substrate as a circuit carrier with all elements attached or as a carrier for a particular device. factors. Two invited review oaDers summarize the most recent developments in ferromagnetic parts and lumped elements for microwave integrated circuits. These papers are augmented by a theoretical treatment of modes in ferrite substrate. Several papers on systems are presented next. These papers illustrate the large variety of practical applications in which hybrid microwave integrated circuits have been employed. Two papers on mixers provide additional techniques by which mixer performance was enhanced. The final paper shows a special application of microwave integrated circuit technology to filter design. Unique applications and techniques are shown in the contributions to the correspondence section. Included are a trilmming technique applicable to monolithic and hybrid integrated circuits, two applications for switches, a slot line application, two circulator designs, a technique for measuring the substrate dielectric constant, and a technique for determining package resonances.

Abstracts

Modes in the Shielded Microstrip on a Ferrite Substrate Transversely Magnetized in the Plane of the Substrate

J.C. Minor and D.M. Bolle. "Modes in the Shielded Microstrip on a Ferrite Substrate Transversely Magnetized in the Plane of the Substrate." 1971 Transactions on Microwave Theory and Techniques 19.7 (Jul. 1971 [T-MTT] (Special Issue on Microwave Integrated Circuits)): 570-577.

The shielded microstrip on a ferrite substrate transversely magnetized in the plane of the substrate is analyzed using an appropriate modal expansion in each of the two media. The boundary conditions at the interface are then expressed in terms of two coupled integral equations which are subsequently solved by the method of moments. Information on the singularities in the fields near the edges is used in the computations to obtain the eigenvalue beta within an estimated 0.5-percent accuracy using matrices as small as 5x5. Comparison with various published results for the microstrip is made in the lid case of a dielectric substrate. An omega-beta plot is presented for one particular ferrite-loaded configuration which shows slight non-reciprocity in both the fundamental and higher order modes.

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Ferrimagnetic Parts for Microwave Integrated Circuits

G.R. Harrison, G.H. Robinson, B.R. Savage and D.R. Taft. "Ferrimagnetic Parts for Microwave Integrated Circuits." 1971 Transactions on Microwave Theory and Techniques 19.7 (Jul. 1971 [T-MTT] (Special Issue on Microwave Integrated Circuits)): 577-588.

Tremendous technological strides have been made in recent years in the development of miniaturized microwave components and modules using microstrip transmission lines in combination with both semiconductor and ferrite technology. This technology growth has been spurred by rapidly increasing microwave systems complexity and diversity and the need for lower cost, more reliable, and smaller microwave assemblies. This paper describes the design and performance of various ferrimagnetic components as functional blocks for use in microwave integrated modules. The design and performance of the following components are described as well as their utilization in various multifunction modules: junction circulators both fixed bias and latching including their use as isolators, duplexers, switches, modulators, and other signal processing circuits; ferrimagnetic planar phase shifters; various combinations of these circuit elements where both all ferrimagnetic and composite ferrimagnetic/dielectric substrates are utilized.

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Status of Lumped Elements in Microwave Integrated Circuits---Present and Future

M. Caulton, B. Hershenov, S.P. Knight and R.E. DeBrecht. "Status of Lumped Elements in Microwave Integrated Circuits---Present and Future." 1971 Transactions on Microwave Theory and Techniques 19.7 (Jul. 1971 [T-MTT] (Special Issue on Microwave Integrated Circuits)): 588-599.

The use of lumped elements in microwave integrated circuits (MICS) is discussed. The design, fabrication, and performance of networks used in both active and passive circuits are described. Studies on amplifier impedance matching and transforming networks have resulted in the achievement of a 35-dB-gain 6-W-CW 26-percent-efficient amplifier at 2.25 GHz using only lumped elements. Construction of lumped-element low-pass filters and 3-dB quadrature hybrids at S band have produced circuits much smaller than, but with performance comparable to, microstrip distributed circuits. At C band a large-impedance transformer operating as a filter had less than 0.4-dB loss for an impedance transformation close to 20:1. The performance of lumped-element circuits through X band is compared with that of distributed circuits from the standpoint of size, economy, and technological applications. Lumped-element circuits are competitive with distributed circuits through 6 GHz and are practical through 12 GHz.

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Abstracts

Integrated X-Band Sweeping Superheterodyne Receiver

P.J. Meier, H.C. Okean and E.W. Sard. "Integrated X-Band Sweeping Superheterodyne Receiver." 1971 Transactions on Microwave Theory and Techniques 19.7 (Jul. 1971 [T-MTT] (Special Issue on Microwave Integrated Circuits)): 600-609.

The development of an integrated low-noise sweeping superheterodyne receiver is described. Based upon a receiver performance tradeoff study, a group of components were designed and integrated within a single housing occupying 5.9 in, less connectors. The integrated receiver weighs 6.4 oz, including magnets, and contains the following components: a wide-band low-noise tunnel-diode amplifer (TDA), an image-rejection balanced mixer, a varactor-tuned Gunn oscillator, a four-stage IF amplifier, and a quasi-complementary IF output filter. The housing also contains an interstage ferrite isolator, a bias distribution network with subminiature potentiometers, and a branch-line coupler. This coupler permits the injection of an external oscillator and allows the system to be evaluated outside the band covered by the internal Gunn oscillator. This receiver is the first kind to integrate within a minimum volume all the components necessary for a wide-band low-noise rapid-scan X-band imageless superheterodyne receiver. Varactor tuning permitted the entire receiver to be integrated in a package having about one fifth the weight and two fifths the volume of other similar receiver designs (e.g., a receiver utilizing a YIG-tuned oscillator).

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Product Design of a High-Power S-Band MIC Module for Phased Arrays

F.E. Vaccaro, E.E. Bliss, D. Zieger and R.P. Lorentzen. "Product Design of a High-Power S-Band MIC Module for Phased Arrays." 1971 Transactions on Microwave Theory and Techniques 19.7 (Jul. 1971 [T-MTT] (Special Issue on Microwave Integrated Circuits)): 609-616.

The mechanical and electrical design of a 10-W S-band hybrid microwave integrated circuit (MIC) module is described. The module uses transistor chips mounted on a carrier designed for stripline applications. Seventeen units were constructed and representative test data are presented. Phase matching of ±15° was obtained between a group of modules by use of compensating lengths of lines attached to the outputs.

Abstracts

An Array of Pulsed X-Band Microstrip Gunn Diode Transmitters with Temperature Stabilization

M.P. Wasse and E. Denison. "An Array of Pulsed X-Band Microstrip Gunn Diode Transmitters with Temperature Stabilization." 1971 Transactions on Microwave Theory and Techniques 19.7 (Jul. 1971 [T-MTT] (Special Issue on Microwave Integrated Circuits)): 616-622.

The construction of pulsed microstrip Gunn diode transmitters which deliver 5-10 W at 9.4 GHz is described. The oscillators are designed to be used as injection locked elements in a simple phased array system; the necessary phase stability against ambient and in-pulse temperature change being achieved by suitably biasing a varactor diode. Details of the design and performance of the transmitter and its component parts are presented together with preliminary data on a small array.

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An L-Band MIC Front End for an IFF Receiver

R.J. Giannini, S. Anghel and R.L. Camisa. "An L-Band MIC Front End for an IFF Receiver." 1971 Transactions on Microwave Theory and Techniques 19.7 (Jul. 1971 [T-MTT] (Special Issue on Microwave Integrated Circuits)): 622-627.

A microwave integrated circuit (MIC) front end which satisfies stringent environmental and filtering requirements has been developed; the design objectives were based on the requirements typical of an L-band receiver for an identification friend or foe (IFF) transponder. The front end includes a preselector, a balanced mixer, and a multiplier for providing the local oscillator (LO) signal. A compact low-loss design has been achieved for the bandpass filter portion of the preselector through the use of "hairpin" resonators. Use of a semilumped 3-dB coupler has resulted in a significant reduction in the size of the mixer. The front-end noise figure was measured to be 10.4 dB at room temperature, with a maximum of 14.0 dB at 125°C. All spurious responses were measured to be more than 80 dB down, and LO reradiation was -67 dBm. Dynamic range was greater than 70 dB.

Abstracts

Ku-Band Electronically Tunable Monopulse Receiver

J.M. Osterwalder. "Ku-Band Electronically Tunable Monopulse Receiver." 1971 Transactions on Microwave Theory and Techniques 19.7 (Jul. 1971 [T-MTT] (Special Issue on Microwave Integrated Circuits)): 627-633.

Techniques employed for Ku-band hybrid integrated microstrip components are discussed along with their performance data. The final integration results in a complete monopulse receiver with its own electronically tunable Gunn oscillator in a total packaged volume of 2.1 in^3. Materials and their limitations are discussed. Electronically tunable Gunn oscillator performance at Ku band is demonstrated which leads finally to a brief discussion of the dynamic impedance properties of negative resistance diodes.

Abstracts

4-GHz Integrated-Circuit Mixer

M. Katoh and Y. Akaiwa. "4-GHz Integrated-Circuit Mixer." 1971 Transactions on Microwave Theory and Techniques 19.7 (Jul. 1971 [T-MTT] (Special Issue on Microwave Integrated Circuits)): 634-637.

We have calculated the conversion loss for microwave diode mixers taking into account the effects of series resistance and barrier capacitance in the diode and the internal resistance of the local oscillator. The relations between the conversion loss and the parameters, which are important for the design of the diode mixer, are clarified. A 4-GHz integrated-circuit low-noise mixer is developed. The minimum overall noise figure obtained is 4.1 dB with a short-circuited image-frequency termination.

Abstracts

A 20-GHz Integrated Balanced Mixer

T. Araki and M. Hirayama. "A 20-GHz Integrated Balanced Mixer." 1971 Transactions on Microwave Theory and Techniques 19.7 (Jul. 1971 [T-MTT] (Special Issue on Microwave Integrated Circuits)): 638-643.

An integrated balanced mixer for use in the receiver for the quasi-millimeter-wave digital radio transmission system is described. The following aspects of the mixer realization are discussed. 1) The characteristics of gallium arsenide Schottky barrier diodes and three types of diode mount construction are described. The least observed dc incremental conversion loss was about 4 dB in the range of 18-23 GHz. 2) The fabrication of waveguide to microstrip transition, using a ridged waveguide transducer, is described. A transition loss of less than 0.38 dB was obtained in the range of 18-21.75 GHz. 3) The microstrip circuit elements, such as the 3-dB directional coupler and the low-pass filter, are described. The minimum isolation and coupling values of the coupler were about 16 dB and 3-4 dB, respectively. 4) The effect of the undesirable electromagnetic mode propagation on the integrated mixer operations is discussed. 5) The performance of the integrated balanced mixer is presented. This mixer, operated at a signal frequency of 20 ±0.5 GHz and at a local oscillator frequency of 18.3 GHz, showed a single side-band noise figure of 4.8-5.8 dB. 6) The reliability of the mixer is also evaluated with high reliability under vibration and shock testing being exhibited.

Abstracts

Dielectric Resonator Filters for Application in Microwave Integrated Circuits

T.D. Iveland. "Dielectric Resonator Filters for Application in Microwave Integrated Circuits." 1971 Transactions on Microwave Theory and Techniques 19.7 (Jul. 1971 [T-MTT] (Special Issue on Microwave Integrated Circuits)): 643-652.

Design of bandpass filters for microwave integrated circuits (MICS) utilizing dielectric resonators is discussed. Synthesis methods for both Tschebycheff and Butterworth responses are derived. Experimental results with S- and X-band filters are presented, and the agreement between theory and experiments is shown to be fairly good. Limitations on this technique due to poor temperature stability are also discussed.

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Trimming of Microstrip Circuits Utilizing Microcantilever Air Gaps (Correspondence)

T.MS. Heng. "Trimming of Microstrip Circuits Utilizing Microcantilever Air Gaps (Correspondence)." 1971 Transactions on Microwave Theory and Techniques 19.7 (Jul. 1971 [T-MTT] (Special Issue on Microwave Integrated Circuits)): 652-654.

A reliable method of tuning and microwave integrated circuit (MIC) line connection which has potential up to X band has been demonstrated. The method utilizes integrable fabricated microcantilever air gaps which are cold-deformed in situ to accomplish trimming. The advantages of this concept are 1) high open-circuit impedance, 2) low short-circuit insertion loss, 3) high trim resolution, 4) low line perturbation, 5) high mechanical stability, and 6) in situ fabrication with the rest of MIC circuitry.

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A 90-dB Microstrip Switch on a Plastic Substrate (Correspondence)

B.R. Hallford. "A 90-dB Microstrip Switch on a Plastic Substrate (Correspondence)." 1971 Transactions on Microwave Theory and Techniques 19.7 (Jul. 1971 [T-MTT] (Special Issue on Microwave Integrated Circuits)): 654-657.

A single-pole double-throw (SPDT) microstrip switch has been designed on a plastic (polyolefin) substrate to switch two 10-W CW carriers into a common load over the frequency range 1.7 to 2.3 GHz. No tuning adjustments are used over this 30-percent bandwidth to obtain a 90-dB minimum isolation, a 23-dB minimum return loss, and a 1-dB maximum insertion loss. Units now in production typically have a 0.6-dB insertion loss, a 26-dB return loss, and isolation levels of 105 ±5 dB.

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Octave Bandwidth Adjustable SPDT Power Switch Using p-i-n Diode-Terminated Stubs (Correspondence)

H.-N. Toussaint and R. Hoffman. "Octave Bandwidth Adjustable SPDT Power Switch Using p-i-n Diode-Terminated Stubs (Correspondence)." 1971 Transactions on Microwave Theory and Techniques 19.7 (Jul. 1971 [T-MTT] (Special Issue on Microwave Integrated Circuits)): 657-659.

A new two-diode single-pole double-throw (SPDT) power-switch with the operating frequency adjustable within one octave is presented. An experimental model of the switch showed frequency adjustments in narrow bandwidth operation between 0.65 and 1.3 GHz. Frequency adjustment is made by appropriately short-circuiting a transmission line. Using thin-film microstrip lines, the switch was buitt on a 50-mil-thick 1-in by 1-in Al/sub 2/O/sub 3/ ceramic substrate. Switching speed is 100 to 300 ns; power handling capability is 1.5-kW peak power at 1-percent duty factor.

Abstracts

A Wide-Band Quadrature Hybrid Coupler (Correspondence)

J.A. Garcia. "A Wide-Band Quadrature Hybrid Coupler (Correspondence)." 1971 Transactions on Microwave Theory and Techniques 19.7 (Jul. 1971 [T-MTT] (Special Issue on Microwave Integrated Circuits)): 660-661.

Wide-band quadrature hybrid proximity couplers consist of a conductor fabricated by thin-film techniques in microstrip the conductor side and a slot in the ground plane side. A 4 to 1 bandwidth was achieved using an alumina substrate of 99.6-percent purity with a surface finish of 10 µin. A single-section quadrature hybrid has been fabricated and operates over a 2.5- to 10-GHz frequency range with a maximum VSWR of 1.43:1, a 20-dB typical isolation, and a phase difference between outputs of 90° ± 3°.

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An Integrated Microstrip Circulator (Correspondence)

A.L. Poirier. "An Integrated Microstrip Circulator (Correspondence)." 1971 Transactions on Microwave Theory and Techniques 19.7 (Jul. 1971 [T-MTT] (Special Issue on Microwave Integrated Circuits)): 661-662.

Ferrite circulators, incorporated as integral parts of a microstrip circuit on a copper-clad dielectric substrate, have been developed and tested. These circulators do not require the machining of a hole in the dielectric substrate or etching of the ferrite metalization. 20-dB isolation bandwidths of 3.5 to 4 percent in the frequency range 1.75 to 2.23 GHz were measured.

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A 30-GHz Inverted-Microstrip Circulator (Correspondence)

R. Trambarulo. "A 30-GHz Inverted-Microstrip Circulator (Correspondence)." 1971 Transactions on Microwave Theory and Techniques 19.7 (Jul. 1971 [T-MTT] (Special Issue on Microwave Integrated Circuits)): 662-664.

A 3-port inverted-microstrip circulator has been built which operates near 30 GHz with an isolation of greater than 20 dB over a 6-percent bandwidth. The circulator junction has an insertion loss of less than 0.4 dB over the band exclusive of losses in transitions used for testing the device.

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A Simple Technique for the Accurate Determination of the Microwave Dielectric Constant for Microwave Integrated Circuit Substrates (Correspondence)

L.S. Napoli and J.J. Hughes. "A Simple Technique for the Accurate Determination of the Microwave Dielectric Constant for Microwave Integrated Circuit Substrates (Correspondence)." 1971 Transactions on Microwave Theory and Techniques 19.7 (Jul. 1971 [T-MTT] (Special Issue on Microwave Integrated Circuits)): 664-665.

A method of determining the microwave dielectric constant of microwave integrated circuit substrates is described. The technique is especially suitable to substrates being prepared for MICs since they are, in general, regular, rectangular, and, therefore, simple resonators. The dielectric constant using this technique has been determined in the 2- to 12-GHz range for GaAs (epsilon R = 12.46), sapphire (epsilon R = 9.37), polyguide (epsilon = 2.33), and Alsimag 772 (epsilon R = 10.08).

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Resonant Frequency Calculations for Microstrip Cavities (Correspondence)

G.H. Robinson. "Resonant Frequency Calculations for Microstrip Cavities (Correspondence)." 1971 Transactions on Microwave Theory and Techniques 19.7 (Jul. 1971 [T-MTT] (Special Issue on Microwave Integrated Circuits)): 665-666.

Microstrip circuits in metal enclosures frequently exhibit loss spikes. These spikes are sometimes shown to be related to cavity resonances whose frequency can be calculated from enclosure dimensions using known theory. These calculations are presented graphically so that resonant frequencies may be determined for a particular structure or resonances within a band avoided through judicious choice of enclosure dimensions. Comparison of experimental and calculated results are tabulated.

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Abstracts

The Razor Search Program (Computer Program Descriptions)

J.W. Bandler and P.A. Macdonald. "The Razor Search Program (Computer Program Descriptions)." 1971 Transactions on Microwave Theory and Techniques 19.7 (Jul. 1971 [T-MTT] (Special Issue on Microwave Integrated Circuits)): 667-667.

The razor search program is a package of subroutines which locates the minimum of a function of several variables by the razor search method of Bandler and Macdonald.

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Y. Akaiwa, S. Anghel, T. Araki, E.E. Bliss, D.M. Bolle, R.L. Camisa, M. Caulton, R.E. DeBrecht, E. Denison, R.J. Giannini, G.R. Harrison, B. Hershenov, M. Hirayama, T.D. Iveland, M. Katoh, S.P. Knight, R.P. Lorentzen, P.J. Meier, J.C. Minor, H.C. Okean, J.M. Osterwalder, G.H. Robinson, E.W. Sard, B.R. Savage, D.R. Taft, F.E. Vaccaro, M.P. Wasse and D. Zieger. "Contributors (Jul. 1971 [T-MTT])." 1971 Transactions on Microwave Theory and Techniques 19.7 (Jul. 1971 [T-MTT] (Special Issue on Microwave Integrated Circuits)): 668-671.

Abstracts

Information on Computer Program Descriptions (Jul. 1971 [T-MTT])

"Information on Computer Program Descriptions (Jul. 1971 [T-MTT])." 1971 Transactions on Microwave Theory and Techniques 19.7 (Jul. 1971 [T-MTT] (Special Issue on Microwave Integrated Circuits)): 672-672.

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Abstracts

Variational Bound Principle for Multimode Waveguide Scattering

K. Kalikstein and C.J. Kleinman. "Variational Bound Principle for Multimode Waveguide Scattering." 1971 Transactions on Microwave Theory and Techniques 19.8 (Aug. 1971 [T-MTT]): 673-677.

A variational bound (VB) principle is presented for evaluating the matrix elements of a network representation of lossless obstacles in multimode waveguides. The formalism is based on a quantum mechanical VB principle for multichannel (multiport) scattering and is a first attempt to apply the VB method to a multi-mode problem. The procedure for determining the functions required in the application of the VB method is illustrated for a rectangular waveguide propagating two modes that are coupled by a dielectric obstacle.

Abstracts

Synthesis of Combline and Capacitively Loaded Interdigital Bandpass Filters of Arbitrary Bandwidth

R.J. Wenzel. "Synthesis of Combline and Capacitively Loaded Interdigital Bandpass Filters of Arbitrary Bandwidth." 1971 Transactions on Microwave Theory and Techniques 19.8 (Aug. 1971 [T-MTT]): 678-686.

Synthesis procedures are presented for commensurate linelength combline and capacitively loaded interdigital filters. A simple modification for using lumped capacitors is given and is found to yield excellent results for any practical bandwidth. The synthesis procedures for both filter types follow directly from the classical bandpass filter design approach using a transformed frequency variable. Two design examples are given to illustrate the design procedures and experimental results are presented for a 40 percent bandwidth combline filter. The problems of network sensitivity, use of network equivalents, and extension to other filter types are also discussed.

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Determination of Equivalent Circuit Parameters Describing Noise from a Gunn Oscillator

S. Hashiguchi and T. Okoshi. "Determination of Equivalent Circuit Parameters Describing Noise from a Gunn Oscillator." 1971 Transactions on Microwave Theory and Techniques 19.8 (Aug. 1971 [T-MTT]): 686-691.

The AM and FM fluctuations in an oscillator output are originated from impedance fluctuation in low frequencies (baseband noise) and voltage or current fluctuation in the vicinity of the carrier frequency (RF noise). In this paper, from newly defined "complex correlation coefficient between AM and FM noises," contributions of baseband and RF noises to the AM and FM noises are determined. Examples of data for X-band Gunn oscillators show that both the AM and FM noises are mainly caused by the baseband noise in the vicinity of the carrier frequency (within 1-kHz band), whereas they are mainly due to the RF noise at frequencies further than 10 kHz from the carrier frequency.

Abstracts

Noise in IMPATT Diode Amplifiers and Oscillators

H.-J. Thaler, G. Ulrich and G. Weidmann. "Noise in IMPATT Diode Amplifiers and Oscillators." 1971 Transactions on Microwave Theory and Techniques 19.8 (Aug. 1971 [T-MTT]): 692-705.

The results of experimental and theoretical investigations of the noise characteristics of IMPATT diode amplifiers and oscillators are presented. The oscillator noise is shown to consist of three different contributions: modulation noise, selectively amplified primary noise, and conversion noise. The influence of the active device nonlinearity and load circuit parameters is discussed in detail. The experimental results are in good agreement with the theoretical predictions. It is especially pointed out that the large correlation between AM and FM fluctuations, usually measured in IMPATT oscillators, indicates nonoptimum AM noise performance. Experimental techniques for achieving optimum AM noise performance are demonstrated (orthogonal noise tuning). By a simple extension of the model, the noise behavior of an injection phase-locked oscillator can be described. The calculated AM and FM noise power spectra for the synchronized oscillator are also shown to be in good agreement with experimental results. Finally the signal-to-noise ratio for current modulated IMPATT oscillators is investigated and optimization is demonstrated.

Abstracts

Theoretical and Experimental Analysis of a Waveguide Mounting Structure

R.L. Eisenhart and P.J. Khan. "Theoretical and Experimental Analysis of a Waveguide Mounting Structure." 1971 Transactions on Microwave Theory and Techniques 19.8 (Aug. 1971 [T-MTT]): 706-719.

The induced EMF method has been extended and applied to derive the driving-point impedance of a common waveguide structure used for mounting small microwave devices. An equivalent circuit is developed and discussed in detail. Theoretical impedance curves are presented demonstrating the circuit characteristics for various configurations of the mount. The driving-point impedance of this mount has also been considered experimentally. A novel measurement technique is used based upon the use of subminiature coaxial line to gain electrical access to the terminal pair located inside the waveguide. A model of the measurement circuit, which enhances the accuracy of the results, providing excellent agreement between the theoretical and measured values, is developed. The multilateral nature of the circuit allows consideration of the mount in the waveguide as an obstacle to any incident propagating mode. Some related measurements have been made using standard techniques for the H/sub 10/ mode. It is anticipated that this formulation will permit accurate design of many components which previously required empirical methods based on limited experimental data.

Abstracts

Continuous Mode Spectrum of a Circular Dielectric Rod

A.W. Snyder. "Continuous Mode Spectrum of a Circular Dielectric Rod." 1971 Transactions on Microwave Theory and Techniques 19.8 (Aug. 1971 [T-MTT]): 720-727.

The continuous modes for a circular dielectric rod are derived. These modes are identified with the fields due to the scattering of a plane wave at oblique incidence from a dielectric rod, thus providing insight into their behavior. This identification suggests that the modes be classified as incident transverse magnetic (ITM) modes when the incident plane-wave portion of H/sub z/ is zero and as incident transverse electric (ITE) modes when the incident plane-wave portion of E/sub z/ is zero. The transition region from discrete to continuous modes is analyzed in detail. Very simple approximate modes are derived for use in optical waveguide studies.

Abstracts

Varactor Q Measurement (Correspondence)

J.M. Roe. "Varactor Q Measurement (Correspondence)." 1971 Transactions on Microwave Theory and Techniques 19.8 (Aug. 1971 [T-MTT]): 728-729.

A technique is presented for measuring the Q of a varactor diode junction when external loss is present. No tuning of the test mount is required, and the need for separate capacitance measurements is eliminated. A numerical data processing technique is illustrated which permits rapid determination of the Q from the measured data.

Abstracts

A Continuously Variable Dielectric Phase Shifter (Correspondence)

W.T. Joines. "A Continuously Variable Dielectric Phase Shifter (Correspondence)." 1971 Transactions on Microwave Theory and Techniques 19.8 (Aug. 1971 [T-MTT]): 729-732.

A stripline phase shifter is described which yields a linear variable phase shift versus frequency. The phase shift is accomplished by varying the dielectric constant of the medium through which the signal propagates. Characteristic impedance is kept constant at all phase shift settings; hence, in theory, no reflections are produced. Measurements made over the 1 to 2 GHz band show the maximum voltage standing-wave ratio (VSWR) to be 1.15. Measured values of insertion phase shift over the same frequency band show good agreement with theory (maximum difference about 2.5 percent).

Abstracts

A Low-Inductance Millimeter-Wave Semiconductor Package (Correspondence)

R.R. Spiwak. "A Low-Inductance Millimeter-Wave Semiconductor Package (Correspondence)." 1971 Transactions on Microwave Theory and Techniques 19.8 (Aug. 1971 [T-MTT]): 732-733.

A low-inductance semiconductor device package has been fabricated for use in the microwave and millimeter-wave ranges where the parasitic resonances of conventional packages interfere with circuit design. This method of packaging eliminates the use of springs or ribbons normally used to contact the semiconductor and has resulted in a package in which the first self-resonance is calculated to be over 200 GHz. The package has been used successfully in several experimental applications over the past two years.

Abstracts

Equations for Calculating the Dielectric Constant of Saline Water (Correspondence)

A. Stogryn. "Equations for Calculating the Dielectric Constant of Saline Water (Correspondence)." 1971 Transactions on Microwave Theory and Techniques 19.8 (Aug. 1971 [T-MTT]): 733-736.

The dielectric constant of saline water may be represented by an equation of the Debye form. Equations for the parameters in the Debye expression are given as functions of the water temperature and salinity.

Abstracts

Scattering of a Shielded Surface Wave in a Coaxial Waveguide by a Wall Impedance Discontinuity (Correspondence)

S. Vijayaraghavan and R.K. Arora. "Scattering of a Shielded Surface Wave in a Coaxial Waveguide by a Wall Impedance Discontinuity (Correspondence)." 1971 Transactions on Microwave Theory and Techniques 19.8 (Aug. 1971 [T-MTT]): 736-739.

The Wiener-Hopf technique is used to calculate the transmission and reflection coefficients of a shielded surface wave in a coaxial waveguide with inductively reactive inner surface and perfectly conducting outer surface and characterized by an abrupt wall reactance discontinuity. A lumped parameter equivalent circuit is derived for the discontinuity.

Abstracts

Contributors (Aug. 1971 [T-MTT])

R.L. Eisenhart, S. Hashiguchi, K. Kalikstein, P.J. Khan, C.J. Kleinman, T. Okoshi, A.W. Snyder, H.-J. Thaler, G. Ulrich, G. Weidmann and R.J. Wenzel. "Contributors (Aug. 1971 [T-MTT])." 1971 Transactions on Microwave Theory and Techniques 19.8 (Aug. 1971 [T-MTT]): 739-740.

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Abstracts

Distortion Performance of the Abrupt-Junction Current-Pumped Varactor Frequency Converter

J.G. Gardiner and S.I. Ghobrial. "Distortion Performance of the Abrupt-Junction Current-Pumped Varactor Frequency Converter." 1971 Transactions on Microwave Theory and Techniques 19.9 (Sep. 1971 [T-MTT]): 741-749.

Intermodulation distortion in abrupt-junction current-pumped varactor frequency converters is usually attributed to gain compression effects. In the present work an analytical procedure is formulated in which distortion generation and gain saturation effects are seen to arise as a consequence of the interaction of signals, pump, and generated products with the nonlinear capacitance of the varactor. Good agreement is demonstrated between predicted distortion levels and those measured in an experimental upper-sideband up-converter operating at VHF with low gain and high level drive to minimize gain compression effects.

Abstracts

A Class of Minimum-Phase Microwave Filters with Simultaneous Conditions on Amplitude and Delay

S.O. Scanlan and T.P. Pantzaris. "A Class of Minimum-Phase Microwave Filters with Simultaneous Conditions on Amplitude and Delay." 1971 Transactions on Microwave Theory and Techniques 19.9 (Sep. 1971 [T-MTT]): 749-759.

The class of filters considered here is such that with a prescribed numerator for the transducer power gain (a constant or (1- lambda²)/sup r/) the available degrees of freedom are divided to provide some zero derivatives of delay and some zero derivatives of the amplitude response at the origin. This enables one to progress in a smooth fashion from the maximally flat amplitude response to the maximally flat delay response. The results are derived by starting from the key case where the numbers of zero derivatives in amplitude and delay are equal. Results are presented for all-stub, cascaded transmission line, and interdigital realizations, and it is indicated how the technique may be applied for any prescribed even numerator in the transducer power gain. The results obtained indicate that this class of functions is particularly suitable for relatively wide passbands.

Abstracts

Microwave Bandwidth Active Transversal Filter Concept With MESFETs

W. Jutzi. "Microwave Bandwidth Active Transversal Filter Concept With MESFETs." 1971 Transactions on Microwave Theory and Techniques 19.9 (Sep. 1971 [T-MTT]): 760-767.

An active transversal filter concept for microwave frequencies is proposed. Silicon metal semiconductor field-effect transistors (MESFETs) with high impedances are used as active coupling elements. A hardware implementation yields a minimum interval between equalized pulses of 1.5 ns. Simulations with improved MESFETs predict equalization for smaller pulse intervals than 400 ps.

Abstracts

Waveguide Power-Mode Theorems for Nonconservative Systems

P. Chorney and P. Penfield, Jr.. "Waveguide Power-Mode Theorems for Nonconservative Systems." 1971 Transactions on Microwave Theory and Techniques 19.9 (Sep. 1971 [T-MTT]): 767-772.

The waveguide power-mode theorems derived earlier apply to lossless passive waveguide systems. These theorems are now extended in three ways. First, nonconservative (e.g., lossy or active) systems are treated. Second, the theorems are generalized to account for complex frequency. Third, plasmas and relativistic electron beams are included by considering the mechanical equations of this "medium" explicitly. It is found that in general, the propagation constants, attenuation constants, real power, and reactive power can all be interrelated. The pseudo-energy terms in general are complex.

Abstracts

Sandwich Slot Line (Correspondence)

S.B. Cohn. "Sandwich Slot Line (Correspondence)." 1971 Transactions on Microwave Theory and Techniques 19.9 (Sep. 1971 [T-MTT]): 773-774.

Formulas and curves are given for the relative wavelength and characteristic impedance of sandwich (double-substrate) slot line. A field plot shows that the slot-wave field components are closely confined to the vicinity of the slot, and the H field is elliptically polarized near the outer surfaces of the sandwich.

Abstracts

A Microwave Hybrid with Impedance Transforming Properties (Correspondence)

H. Sobol. "A Microwave Hybrid with Impedance Transforming Properties (Correspondence)." 1971 Transactions on Microwave Theory and Techniques 19.9 (Sep. 1971 [T-MTT]): 774-776.

A 3-port hybrid useful for combining equiphase equiamplitude signals or for dividing an input into two such signals is described. Design equations are presented for matching arbitrary complex loads at the equiphase-equiamplitude ports to a real load at the third port.

Abstracts

Apparent Frequency Dependence of the Microwave Power Radiated from Gas Discharge Noise Sources (Correspondence)

K.W. Olson. "Apparent Frequency Dependence of the Microwave Power Radiated from Gas Discharge Noise Sources (Correspondence)." 1971 Transactions on Microwave Theory and Techniques 19.9 (Sep. 1971 [T-MTT]): 776-777.

Historically it has been assumed that the microwave power per unit bandwidth radiated from the plasma of typical argon and neon gas discharge noise sources is frequency independent. There are now both a priori basis and experimental evidence for questioning this assumption. For such frequency independence to exist over a frequency range of 100 MHz to 100 GHz the following conditions must be met: (1) /spl planck/omega / kT<<1; (2) proper matching of the discharge to the guide; (3) an appropriate level of absorptivity of the plasma for these frequencies; (4) a Maxwellian electron velocity distribution function; and (5) absence of collective oscillations. The first three conditions are shown to be met. The fourth condition involves the concept of a radiation temperature. Because the appropriate electron velocity distributions are not Maxwellian this radiation temperature does depend somewhat on frequency. This dependence is limited to a small region around the electron-atom collision frequency. For the discharges of concern it is shown that these collision frequencies are 10/sup 9/ to 10/sup 10/s/sup -1/ and therefore contained in the frequency range of interest. The fifth condition relates to the fourth and recently has been shown in theory to be untrue. Finally there is now available experimental evidence which appears to show a small (0.2-0.3 dB) variation of excess noise ratio with frequency on existing tubes. Suggestions for future experiments and interim considerations are made.

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The Influence of Conducting Walls on Resonant Frequencies of the Dielectric Microwave Resonator (Correspondence)

S. Fiedziuszko and A. Jelenski. "The Influence of Conducting Walls on Resonant Frequencies of the Dielectric Microwave Resonator (Correspondence)." 1971 Transactions on Microwave Theory and Techniques 19.9 (Sep. 1971 [T-MTT]): 778-779.

Equations are given from which the resonant frequencies of dielectric resonators can be calculated taking into account the influence of the conducting walls of the microwave structures in which these resonators are inserted. The comparison between theoretical and experimental results shows the validity of the theoretical model.

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Double Dielectric Resonator (Correspondence)

S. Fiedziuszko and A. Jelenski. "Double Dielectric Resonator (Correspondence)." 1971 Transactions on Microwave Theory and Techniques 19.9 (Sep. 1971 [T-MTT]): 779-781.

Equations are derived from which the resonant frequencies of the double dielectric resonators can be calculated taking into account the influence of the conducting walls of the waveguide or the strip line. A comparison between theoretical and experimental results is also given.

Abstracts

A Relationship Between the Scattering Parameters of a Passive Lossy Nonreciprocal Two-Port (Correspondence)

H.J. Hindin. "A Relationship Between the Scattering Parameters of a Passive Lossy Nonreciprocal Two-Port (Correspondence)." 1971 Transactions on Microwave Theory and Techniques 19.9 (Sep. 1971 [T-MTT]): 781-781.

A previously unpublished relationship is derived for the scattering coefficients of a passive lossy nonreciprocal two-port. The relationship, in the form of an inequality, is a generalization of a result of Uhlir.

Abstracts

An Adjustable-Slot-Length UHF Coaxial Coupler with Decade Bandwidth (Correspondence)

P.A. Hudson and L.F. Saulsbery. "An Adjustable-Slot-Length UHF Coaxial Coupler with Decade Bandwidth (Correspondence)." 1971 Transactions on Microwave Theory and Techniques 19.9 (Sep. 1971 [T-MTT]): 781-783.

A coaxial directional coupler has been developed which allows adjustment of the length of the coupling slot to lambda/4 or 3lambda/4 throughout the frequency range 0.3 to 8.5 GHz. Coupling is flat to within 0.05 dB from 0.3 to 3 GHz (lambda/4 mode) and 0.1 dB from 0.9 to 8.5 GHz (3lambda/4 mode). The coupler has 50-dB coupling, 30- to 40dB directivity and was designed primarily for high power measurement (1 to 1000 W) using a low-power meter on the sidearm. The VSWR for the two modes of operation is 1.02 to 1.05. Five octave bandwidth-type couplers would be required to cover this same frequency range.

Abstracts

Dispersion in Microstrip (Correspondence)

W.J. Chudobiak, O.P. Jain and V. Makios. "Dispersion in Microstrip (Correspondence)." 1971 Transactions on Microwave Theory and Techniques 19.9 (Sep. 1971 [T-MTT]): 783-784.

An empirically derived equation is given which describes the apparent variations of epsilon/sub eff/ with frequency in microstrip transmission lines for a wide range of dielectric constants and w/h ratios. The equation demonstrates the relation between dispersion and substrate thickness.

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Ferrite-Loaded Helical Line with Coaxial Inner Conductor (Correspondence)

K.P. Ivanov and S.I. Ganchev. "Ferrite-Loaded Helical Line with Coaxial Inner Conductor (Correspondence)." 1971 Transactions on Microwave Theory and Techniques 19.9 (Sep. 1971 [T-MTT]): 784-786.

A transcendental characteristic equation of a thin-wire cylindrical helix with coaxial inner conductor uniformly filled with circumferentially magnetized gyromagnetic medium is derived in terms of modified Bessel functions and confluent hypergeometric functions. Two special cases of the structure are considered.

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A Fast 3-mm Ferrite Switch (Correspondence)

R.A. Stern. "A Fast 3-mm Ferrite Switch (Correspondence)." 1971 Transactions on Microwave Theory and Techniques 19.9 (Sep. 1971 [T-MTT]): 786-788.

A tetrahedral waveguide junction type of switch has been developed for use in the millimeter region. The design employs a permanent magnet such that the switch operates in the transmission state without any external dc power. By applying a current pulse it switches from the transmission state to the reflective state in 400 ns and back to the transmission state in less than 200 ns. Over the frequency range of 95.5 to 97.2 GHz the switch exhibits a maximum insertion loss of 1.0 dB and a minimum isolation of 25 dB.

Abstracts

Dispersion Relations and Mode Polarizations for Plane-Wave Oscillations in Two-Component Anisotropic Plasma (Computer Program Descriptions)

G.C. Georges and K. Sakuda. "Dispersion Relations and Mode Polarizations for Plane-Wave Oscillations in Two-Component Anisotropic Plasma (Computer Program Descriptions)." 1971 Transactions on Microwave Theory and Techniques 19.9 (Sep. 1971 [T-MTT]): 788-789.

The dispersion relations omega=omega(k) and field polarizations are computed and corresponding graphical outputs are given for the six nontrivial modes that can propagate in unbounded collisionless fluid-model plasma with a static background magnetic field.

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Abstracts

Dielectric Loaded Waveguide Analysis Program (Computer Program Descriptions)

Z. Csendes and P. Silvester. "Dielectric Loaded Waveguide Analysis Program (Computer Program Descriptions)." 1971 Transactions on Microwave Theory and Techniques 19.9 (Sep. 1971 [T-MTT]): 789-789.

This program determines the resonant frequencies and axial electric and magnetic field components in arbitrary polygonal waveguides loaded with isotropic lossless longitudinal dielectric slabs.

Abstracts

Contributors (Sep. 1971 [T-MTT])

P. Chorney, J.G. Gardiner, S.I. Ghobrial, W. Jutzi, T.P. Pantzaris, P. Penfield, Jr. and S.O. Scanlan. "Contributors (Sep. 1971 [T-MTT])." 1971 Transactions on Microwave Theory and Techniques 19.9 (Sep. 1971 [T-MTT]): 790-791.

Abstracts

Information on Computer Program Descriptions (Sep. 1971 [T-MTT])

"Information on Computer Program Descriptions (Sep. 1971 [T-MTT])." 1971 Transactions on Microwave Theory and Techniques 19.9 (Sep. 1971 [T-MTT]): 792-792.

Abstracts

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Abstracts

The Single-Cavity Multiple-Device Oscillator

K. Kurokawa. "The Single-Cavity Multiple-Device Oscillator." 1971 Transactions on Microwave Theory and Techniques 19.10 (Oct. 1971 [T-MTT]): 793-801.

The output power from 12 IMPATT diodes has been combined in a single-cavity multiple-device oscillator. The oscillator is free from the well-known moding problem of multiple-device oscillators. The objective of this paper is to present the oscillator-circuit theory, which clearly indicates why this particular circuit configuration can give a stable operation free from moding problems. To handle the formidable equations necessary for the analysis, the eigenfunction approach is extensively used. The condition for stable operation, the noise performance, and the locking behavior of the oscillator are all discussed. The noise performance is similar and the locking behavior identical to those of single-device oscillators.

Abstracts

Optimum Noise Measure of IMPATT Diodes

H.A. Haus, H. Statz and R.A. Pucel. "Optimum Noise Measure of IMPATT Diodes." 1971 Transactions on Microwave Theory and Techniques 19.10 (Oct. 1971 [T-MTT]): 801-813.

An attempt is made to determine some of the factors responsible for the noise performance of avalanche diodes. In particular we are interested whether there are any lower lids in the noise measure. We derive a theorem which shows that there is a lower limit M/sub opt/ = (½)(q/alpha'/kT) for an IMPATT diode which has a constant value of a', where M/sub opt/ is the optimum noise measure, q is the electronic charge, a' is the derivative with respect to the electric field of the carrier generation rate, k is Boltzmann's constant, and T is the standard absolute temperature. Even though the optimum noise measure is derived for a diode with constant a' in extensive numerical calculations of structures with sections of different a', we never found cases where the overall diode noise figure was lower than calculated by the above formula using the largest value of a'. Detailed calculations show that the lowest noise measure is achieved for carrier transit angles near 2 pi. The negative real part of the impedance becomes rather small when both the transit angle is near 2 pi and when a' is made large. In practical cases it is therefore often not possible to reach noise measures close to M/sub opt/. The paper also investigates how the amplifier noise determines amplitude and frequency noise of the corresponding avalanche oscillators.

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Abstracts

A Monte Carlo Procedure for Potential Theory Problems

G.M. Royer. "A Monte Carlo Procedure for Potential Theory Problems." 1971 Transactions on Microwave Theory and Techniques 19.10 (Oct. 1971 [T-MTT]): 813-818.

A Monte Carlo Procedure is presented which can be used to solve electrostatic and TEM-mode transmission-line problems. A modification of the known Monte Carlo procedures is given, which makes it possible for the method to be used when the dielectric is inhomogenous. Two sources of error are investigated; a partial correction is given for one, and it is shown how the probability confidence limits for the other can be computed.

Abstracts

Junction Reactance and Dimensional Tolerance Effects on X-Band 3-dB Directional Couplers

W.H. Leighton, Jr. and A.G. Milnes. "Junction Reactance and Dimensional Tolerance Effects on X-Band 3-dB Directional Couplers." 1971 Transactions on Microwave Theory and Techniques 19.10 (Oct. 1971 [T-MTT]): 818-824.

Theoretical characteristics are presented for X-band 3-dB rat-race and branch-line couplers using gold microstrip lines with a semi-insulating GaAs dielectric. The rat-race configuration is shown to be less influenced by junction reactance and dimensional tolerances and has a greater bandwidth than the two-branch coupler. However, the rat-race coupler has the disadvantage that the output arms are not adjacent. Three-branch couplers are shown to have bandwidth comparable to the rat-race coupler but are much more sensitive to junction reactance and dimensional tolerances.

Abstracts

Varactor-Tuned Lumped-Element Circulators (Correspondence)

J. Halszajn, D. Walker and F.M. Aitken. "Varactor-Tuned Lumped-Element Circulators (Correspondence)." 1971 Transactions on Microwave Theory and Techniques 19.10 (Oct. 1971 [T-MTT]): 825-826.

In the case of lumped-element circulators, the center frequency of the device can be tuned by altering the lumped capacitance only. It is the purpose of this paper to describe a new voltage-tuned circulator which is obtained by replacing the usual lumped capacitances by varactor diodes. Such a circulator has been tuned over an octave band from 250 to 500 MHz.

Abstracts

Measurement of the Dielectric Constant and Loss Tangent of Liquids by the Transmitted-Reflected Wave Method in the Millimeter-Wave Range (Correspondence)

H. Yamamoto and S. Ohkawa. "Measurement of the Dielectric Constant and Loss Tangent of Liquids by the Transmitted-Reflected Wave Method in the Millimeter-Wave Range (Correspondence)." 1971 Transactions on Microwave Theory and Techniques 19.10 (Oct. 1971 [T-MTT]): 827-829.

A new technique for measuring the dielectric constant and loss tangent of materials in the millimeter-wave range is described. The measurement apparatus and the analysis is considerably simpler than that using conventional techniques. The new technique is based upon a simple geometrical optics approximation, in which a plane reflector is rotated so as to maximize the transmitted-reflected wave power through the material. Only one microwave horn is used in the measurement.

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A 10-GHz Single Sideband Modulator with 1-kHz Frequency Shift (Correspondence)

P.G. Brooker and J.D.E. Beynon. "A 10-GHz Single Sideband Modulator with 1-kHz Frequency Shift (Correspondence)." 1971 Transactions on Microwave Theory and Techniques 19.10 (Oct. 1971 [T-MTT]): 829-834.

A single sideband modulator which frequency shifts a 10-GHz signal by 1 kHz and which suppresses the carrier and unwanted sideband by 65 dB and >57 dB, respectively, with respect to the wanted sideband, is described. The modulator comprises two commercially available double sideband modulators and a readily constructed high-pass filter. Using the modulator in one arm of a microwave bridge, phase shifts and changes in attenuation of <1° and 0.05 dB have been measured; the low modulating frequency allows audio-frequency circuitry to be used to measure the phase shift and attenuation.

Abstracts

Azimuthally Dependent Magnetostatic Modes in the Cylindrical Ferrites (Correspondence)

M. Masuda, N.S. Chang and Y. Matsuo. "Azimuthally Dependent Magnetostatic Modes in the Cylindrical Ferrites (Correspondence)." 1971 Transactions on Microwave Theory and Techniques 19.10 (Oct. 1971 [T-MTT]): 834-836.

The azimuthally dependent magnetostatic modes have been investigated for two cases: 1) a hollow ferrite pipe is enclosed in a perfectly conducting wall; and 2) a ferrite rod is located at the center of a round waveguide, partially filling the cross section. Our analysis shows that the presence of the dielectric medium has an important role in the determination of the upper bound frequency and the cutoff wave number of the magnetostatic surface modes.

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The Impedance and Scattering Properties of a Plane Annulus Surrounding a Goubau Line (Correspondence)

E.S. Gillespie. "The Impedance and Scattering Properties of a Plane Annulus Surrounding a Goubau Line (Correspondence)." 1971 Transactions on Microwave Theory and Techniques 19.10 (Oct. 1971 [T-MTT]): 837-839.

The impedance and scattering properties of a perfectly conducting plane annulus surrounding a Goubau line is investigated. Computations based upon data from a previous paper by Gillespie and Gustincic are presented. They include the transmission coefficient with the obstacle on the line, the impedance of the obstacle, and the fractions of power transmitted, reflected, and radiated.

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Higher Waveguide Modes by Positive Definite SOR (Computer Program Descriptions)

M. Beaubien and A. Wexler. "Higher Waveguide Modes by Positive Definite SOR (Computer Program Descriptions)." 1971 Transactions on Microwave Theory and Techniques 19.10 (Oct. 1971 [T-MTT]): 839-840.

The program locates fundamental and higher mode cutoff wavenumbers and generates discrete field data. In addition, mode impedances and attenuation coefficients due to wall loss are calculated.

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H.A. Haus, K. Kurokawa, W.H. Leighton, Jr., A.G. Milnes, R.A. Pucel, G.M. Royer and H. Statz. "Contributors (Oct. 1971 [T-MTT])." 1971 Transactions on Microwave Theory and Techniques 19.10 (Oct. 1971 [T-MTT]): 841-842.

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Abstracts

A Precision Compact Rotary Vane Attenuator

T.Y. Otoshi and C.T. Stelzried. "A Precision Compact Rotary Vane Attenuator." 1971 Transactions on Microwave Theory and Techniques 19.11 (Nov. 1971 [T-MTT]): 843-854.

The accurate attenuation range of many precision rotary vane attenuators is limited to about 40 dB because of a transmission error term that is not accounted for in the familiar $\cos^2$ Theta attenuation law. This paper presents a modified law that makes it possible to extend the useful dynamic attenuation range. The same modified law also makes it practical to reduce the length of the rotor section and, therefore, to develop compact rotary vane attenuators that are accurate over reduced dynamic attenuation ranges. The modified law requires the additional calibrations of the incremental attenuation and incremental phase change at the 90° vane angle setting. To verify the modified law, a precision compact WR 112 rotary vane attenuator was fabricated and tested. The attenuator has a total dynamic attenuation range of about 30 dB and a rotor section length approximately one-third that of a conventional WR 112 attenuator. Application of the modified law resulted in good agreement between theoretical and measured incremental attenuations over the total dynamic attenuation range.

Abstracts

A Group Theoretic Investigation of the Single-Wire Helix

J.B. Knorr and P.R. McIsaac. "A Group Theoretic Investigation of the Single-Wire Helix." 1971 Transactions on Microwave Theory and Techniques 19.11 (Nov. 1971 [T-MTT]): 854-861.

This paper discusses the way in which symmetry groups may be utilized in the analysis of periodic microwave structures. The theory of group representations is introduced, and the relationship of these representations to the vector electromagnetic fields which are solutions to the Helmholtz equation (subject to the boundary conditions imposed by the microwave structure) is briefly explained. Also explained is the concept of time reversal. Symmetry analysis involves collecting all of the symmetry operations of a microwave structure into a group, and then finding the irreducible representations of that group. Each solution of the Helmholtz equation must belong to an irreducible representation of the space group, and by examining the irreducible representations it is possible to determine the symmetries and degeneracies of the waves. Symmetry analysis is employed to describe some of the characteristics of the waves of the unsupported wire helix and of the single-wire helix supported symmetrically by three dielectric rods. In particular, the conditions for the occurrence of branch crossings on the k-/spl beta/ diagram are discussed.

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Abstracts

Calculation of Capacitance Coefficients for a System of Irregular Finite Conductors on a Dielectric Sheet

P.D. Patel. "Calculation of Capacitance Coefficients for a System of Irregular Finite Conductors on a Dielectric Sheet." 1971 Transactions on Microwave Theory and Techniques 19.11 (Nov. 1971 [T-MTT]): 862-869.

The capacitance coefficients for a system of irregular finite conductors on a dielectric sheet are considered. There are two parts to the Green's function-integral equation approach considered herein: the first deals with a derivation of Green's functions for a desired mathematical model; the second solves the integral equation by a discretization procedure in which a solution for a large number of unknowns is required-a significant limitation. This approach, however, allows treatment of rather complex finite geometric configurations that are useful in the design of modern thin-film circuits. An integral representation of the Green's functions for the desired mathematical model is presented in which ground planes are assumed at finite distances from the dielectric sheet. However, in this paper, final results are obtained only for the case in which ground planes are at infinity. Numerical results are presented for some typical multiconductor systems. For the case of a two-dimensional parallel strip problem, the result of the present analysis compares well with that available in the literature.

Abstracts

Properties of Microstrip Line on Si-SiO/sub 2/ System

H. Hasegawa, M. Furukawa and H. Yanai. "Properties of Microstrip Line on Si-SiO/sub 2/ System." 1971 Transactions on Microwave Theory and Techniques 19.11 (Nov. 1971 [T-MTT]): 869-881.

A parallel-plate waveguide model for the microstrip line formed on the Si-SiO/sub 2/ system is analyzed theoretically and the results are compared with the experiment. The experiment has been performed over wide ranges of frequency, substrate resistivity, and strip width. Existence of three types of fundamental modes is concluded and the condition for the appearance of each mode is clarified. In particular, the slow-wave mode is found to propagate within the resistivity-frequency range suited to the monolithic circuit technology, and its propagation mechanism is discussed. Approximate analysis of the fringing effect is also made for the slow-wave mode.

Abstracts

On Radial Transmission Line Representations of Electromagnetic Fields in an Anisotropic Moving Medium (Correspondence)

I. Fukai and M. Suzuki. "On Radial Transmission Line Representations of Electromagnetic Fields in an Anisotropic Moving Medium (Correspondence)." 1971 Transactions on Microwave Theory and Techniques 19.11 (Nov. 1971 [T-MTT]): 882-883.

The problems of electromagnetic waves in moving isotropic or uniaxial mediums have been dealt with by numerous authors. Chawla and Unz considered the fields in a moving anisotropic plasma, and Chen and Cheng analyzed waves in an isotropic plasma in a moving dielectric medium. In this note we consider electromagnetic fields in a moving anisotropic medium and propose the network formulation of electromagnetic fields in the moving medium in the radial cylindrical coordinate. The method is an extension of the transmission line representation of electron beams on infinite magnetic fields. We can apply these results to the cases of any magnetic field intensity and, further, solve the complex problems for a stationary anisotropic plasma by a similar method.

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An Inhomogeneously Filled Rectangular Waveguide Capable of Supporting TEM Propagation (Correspondence)

R.G. Heeren and J.R. Baird. "An Inhomogeneously Filled Rectangular Waveguide Capable of Supporting TEM Propagation (Correspondence)." 1971 Transactions on Microwave Theory and Techniques 19.11 (Nov. 1971 [T-MTT]): 884-885.

A description is given of a rectangular waveguide partially filled with two dielectric slabs in such a way that the structure is capable of supporting a plane TEM wave in the unloaded space.

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Radiation Conductance of Open-Circuit Microstrip (Correspondence)

H. Sobol. "Radiation Conductance of Open-Circuit Microstrip (Correspondence)." 1971 Transactions on Microwave Theory and Techniques 19.11 (Nov. 1971 [T-MTT]): 885-887.

The radiation conductance of an open-circuit microstrip stub is determined. The losses due to radiation from a stub are shown to be a significant fraction of the total loss.

Abstracts

Broad-Band Properties of a Class of TEM-Mode Hybrids (Correspondence)

R.P. Tetarenko and P.A. Goud. "Broad-Band Properties of a Class of TEM-Mode Hybrids (Correspondence)." 1971 Transactions on Microwave Theory and Techniques 19.11 (Nov. 1971 [T-MTT]): 887-889.

The analysis of a class of N-port TEM-mode hybrids, operating as equal or unequal power dividers or summers, has been extended to include the use of tapered transmission lines. The analysis indicates design limitations on the VSWR and isolation characteristics, and can be applied for arbitrary frequency bandwidth and/or power division ratios. Also included are design graphs and tables that cover some common ranges of power division/summation ratios.

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A Wide-Band Nearly Constant Susceptance Waveguide Element (Correspondence)

J.G. Bryan and F.J. Rosenbaum. "A Wide-Band Nearly Constant Susceptance Waveguide Element (Correspondence)." 1971 Transactions on Microwave Theory and Techniques 19.11 (Nov. 1971 [T-MTT]): 889-891.

Experimental results are presented for a movable metal iris which exhibits a nearly frequency-independent susceptance. This characteristic is related to the susceptance of a centered capacitive obstacle in a waveguide modified by an empirical frequency dependent correction factor.

Abstracts

A Class of Equiripple Functions which Complement the Achieser (or Zolotarev) Polynomials (Correspondence)

H.J. Riblet. "A Class of Equiripple Functions which Complement the Achieser (or Zolotarev) Polynomials (Correspondence)." 1971 Transactions on Microwave Theory and Techniques 19.11 (Nov. 1971 [T-MTT]): 891-892.

A symmetrical cascade of N commensurate transmission lines having equal ripple performance over a passband centered at the quarter-wavelength frequency may be synthesized using Achieser (or Zolotarev) polynomials for N odd. This correspondence identifies the solution of the case where N is even, and a new class of functions which complement these polynomials is identified.

Abstracts

Computer Solution of Transient and Time Domain Thin-Wire Antenna Problems (Computer Program Descriptions)

A.M. Auckenthaler and C.L. Bennet. "Computer Solution of Transient and Time Domain Thin-Wire Antenna Problems (Computer Program Descriptions)." 1971 Transactions on Microwave Theory and Techniques 19.11 (Nov. 1971 [T-MTT]): 892-893.

SWIRE is a general purpose computer program which analyzes the transient and time domain electromagnetic behavior of straight-wire scatterers and antennas (both transmitting and receiving).

Abstracts

Contributors (Nov. 1971 [T-MTT])

M. Furukawa, H. Hasegawa, J.B. Knorr, P.R. McIsaac, T.Y. Otoshi, P.D. Patel, C.T. Stelzried and H. Yanai. "Contributors (Nov. 1971 [T-MTT])." 1971 Transactions on Microwave Theory and Techniques 19.11 (Nov. 1971 [T-MTT]): 893-894.

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"Table of Contents (Dec. 1971 [T-MTT])." 1971 Transactions on Microwave Theory and Techniques 19.12 (Dec. 1971 [T-MTT] (1971 Symposium Issue)): 895-895.

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International Microwave Symposium (Dec. 1971 [T-MTT])

L.R. Whicker. "International Microwave Symposium (Dec. 1971 [T-MTT])." 1971 Transactions on Microwave Theory and Techniques 19.12 (Dec. 1971 [T-MTT] (1971 Symposium Issue)): 896-898.

The 1971 International Microwave Symposium was held in Washington, D.C., on May 17-19 at the Marriott Twin Bridges Motel. The Symposium, in spite of the present economic situation, was both a technical and a financial success. A total registration of 460 was obtained. The success of the Symposium is attributable in part to the hard work of the Symposium Steering Committee, H.W. Cooper, Chairman, and the strong local support from engineers in the Baltimore-Washington area.

Abstracts

G-MTT National Lectureship (Dec. 1971 [T-MTT])

C. Blake. "G-MTT National Lectureship (Dec. 1971 [T-MTT])." 1971 Transactions on Microwave Theory and Techniques 19.12 (Dec. 1971 [T-MTT] (1971 Symposium Issue)): 898-899.

The G-MTT National Lectureship was initiated in 1967 specifically to provide assistance to chapters by providing a prominent speaker on a current microwave topic. Emphasis is placed on aiding new chapters and small chapters located in areas where speakers are not readily available. The goals established for the National Lectureship are to stimulate chapter growth, provide a greater dissemination of current technical information, and establish stronger bonds between the chapters and the National Group. A budget of $2000 per year is provided to cover, or partially defray, the expenses of the National Lecturer. Typically, the National Lecturer will speak at 10-15 chapters during his one-year tenure. Past Lecturers are Harold Sobol (1970), Richard W. Damon (1969), Leo Young (1968), and Arthur A. Oliner (1967). The 1971 National Lecturer is Carl Blake, Massachusetts Institute of Technology Lincoln Laboratory, Lexington. His lecture summary follows.

Abstracts

Experimental and Computer Simulation Analysis of a Gunn Diode (Dec. 1971 [T-MTT])

Y. Ito, H. Komizo, T. Meguro, Y. Daido and I. Umebu. "Experimental and Computer Simulation Analysis of a Gunn Diode (Dec. 1971 [T-MTT])." 1971 Transactions on Microwave Theory and Techniques 19.12 (Dec. 1971 [T-MTT] (1971 Symposium Issue)): 900-905.

Bias-voltage and frequency dependencies of large signal electronic admittance of a Gunn diode have been measured systematically in the 8- to 13-GHz frequency range. The results were qualitatively verified by computer simulation. These results furnished information which was useful in the direct design of broad-band injection-locked oscillators and amplifiers. The results also gave a better understanding of irregular phenomena commonly observed in conventional oscillators.

Abstracts

Behavior of Gunn Diode Oscillator with a Moving Reflector as a Self-Excited Mixer and a Load Variation Detector

S. Nagano and Y. Akaiwa. "Behavior of Gunn Diode Oscillator with a Moving Reflector as a Self-Excited Mixer and a Load Variation Detector." 1971 Transactions on Microwave Theory and Techniques 19.12 (Dec. 1971 [T-MTT] (1971 Symposium Issue)): 906-910.

Behavior of a Gunn diode oscillator with a moving reflector is described. Two cases are considered: The oscillator acts as 1) self-excited mixer and 2) load variation detector. Analyses are carried out by using a simplified model of the dynamic current-voltage characteristic of the Gunn diode oscillator. Experiments have been also carried out. For case 1), an external signal was injected into the oscillator instead of the signal reflected by the reflector. For case 2), the effects of the moving reflector upon the oscillation frequency and dc current were investigated in the static condition. In 1), conversion gain greater than 20 dB has been obtained analytically and experimentally. In 2), it is shown that dc current and the oscillation frequency changes sinusoidally with the phase of reflection coefficient. We can obtain information about the moving reflector through the bias port of the oscillator in both cases.

Abstracts

High-Power Microwave Amplifier Using an Antiparallel Avalanche-Diode Pair (Dec. 1971 [T-MTT])

H. Kawamoto. "High-Power Microwave Amplifier Using an Antiparallel Avalanche-Diode Pair (Dec. 1971 [T-MTT])." 1971 Transactions on Microwave Theory and Techniques 19.12 (Dec. 1971 [T-MTT] (1971 Symposium Issue)): 911-915.

Two high-efficiency avalanche diodes, each placed in opposite polarity to the other at the ends of an approximately one-half wavelength transmission line, have worked as a high-power reflection-type amplifier. The circuit configuration is called an antiparallel pair of high-efficiency avalanche diodes. The antiparallel amplifier has provided 200-W pulsed output power with a 10-dB gain at 1.01 GHz.

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Abstracts

Computer-Aided Design of Parametric Amplifiers (Dec. 1971 [T-MTT])

M. Maeda and A. Sumioka. "Computer-Aided Design of Parametric Amplifiers (Dec. 1971 [T-MTT])." 1971 Transactions on Microwave Theory and Techniques 19.12 (Dec. 1971 [T-MTT] (1971 Symposium Issue)): 916-921.

A computer-aided design approach is developed for the analysis and design of single-tuned parametric amplifiers. The voltage gain-bandwidth product (/spl radic/GB) is used as a maximizing objective function for the optimum design. An 18-GHz single-tuned amplifier using a single-packaged varactor diode is designed as an illustration. The experimental amplifier exhibited a large /spl radic/GB of 2400 MHz and a low noise temperature of 180°K at room temperature ambient.

Abstracts

The Application of Periodic Loading to a Ferrite Phase Shifter Design (Dec. 1971 [T-MTT])

W.G. Spaulding. "The Application of Periodic Loading to a Ferrite Phase Shifter Design (Dec. 1971 [T-MTT])." 1971 Transactions on Microwave Theory and Techniques 19.12 (Dec. 1971 [T-MTT] (1971 Symposium Issue)): 922-928.

The use of a class of periodic structures in the design of low-cost ferrite remanence phase shifters is reported. A loading factor is developed to show the relation of device characteristics to the degree of periodic loading. Results of measurements on a subarray of 64 phase shifters are given to illustrate the repeatability of a described simultaneous assembly technique.

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Abstracts

Lumped-Circuit Elements at Microwave Frequencies

C.S. Aitchison, R. Davies, I.D. Higgins, S.R. Longley, B.H. Newton, J.F. Wells and J.C. Williams. "Lumped-Circuit Elements at Microwave Frequencies." 1971 Transactions on Microwave Theory and Techniques 19.12 (Dec. 1971 [T-MTT] (1971 Symposium Issue)): 928-937.

This paper describes how lumped-circuit elements can be made and used at microwave frequencies. Details are given of lumped capacitors, inductors, resistors, and gyrators. Active combinations of these components and unencapsulated semiconductor chips include a 4-GHz tunnel-diode amplifier, a varactor-tuned X-band Gunn oscillator, a degenerate S-band parametric amplifier and an X-band Doppler radar. It is concluded that the techniques described here are useful at microwave frequencies up to X band.

Abstracts

Generation of Confined-Spectrum Pulses Using an Absorption p-i-n Diode Modulator (Dec. 1971 [T-MTT])

T.A. Saponas. "Generation of Confined-Spectrum Pulses Using an Absorption p-i-n Diode Modulator (Dec. 1971 [T-MTT])." 1971 Transactions on Microwave Theory and Techniques 19.12 (Dec. 1971 [T-MTT] (1971 Symposium Issue)): 938-943.

Using a digital computer the spectrum of a Gaussian envelope pulse can be evaluated to accuracies of better than 0.01 dB over a dynamic range of 100 dB. This technique was used to investigate the problems in existing microwave transmitters. From such a study a low-level absorption-type modulator followed by linear power amplification is a logical method. A commercially available p-i-n diode modulator was then measured on a microwave network analyzer, and, from the resulting amplitude and phase data, the spectrum was computed. The computed prediction of the spectrum was then compared to the measured spectrum and found to agree within 1 dB to -50 dB.

Abstracts

A New Reciprocal Phaser for Use at Millimeter Wavelengths (Correspondence)

L.R. Whicker and C.R. Boyd, Jr.. "A New Reciprocal Phaser for Use at Millimeter Wavelengths (Correspondence)." 1971 Transactions on Microwave Theory and Techniques 19.12 (Dec. 1971 [T-MTT] (1971 Symposium Issue)): 944-945.

A new reciprocal dual-mode phaser for use at millimeter wavelengths is described. The new phaser is economical to fabricate and is geometrically well suited for use in phased array antennas. A 35-GHz model is described which exhibits a 2-GHz bandwidth. The model phaser may be utilized either as a 360° latching device by using flux transfer switching, or can provide up to 800° of differential phase shift with holding current bias. The nominal insertion loss of the phaser is 2 dB with a VSWR <1.3 across its bandwidth. The measured characteristics of the phaser show good agreement with computational values.

Abstracts

Wide-Band Microwave Acoustic Delay Line with Exceptionally Smooth Phase and Loss Response (Correspondence)

W.R. Sperry, E.K. Kirchner and T.M. Reeder. "Wide-Band Microwave Acoustic Delay Line with Exceptionally Smooth Phase and Loss Response (Correspondence)." 1971 Transactions on Microwave Theory and Techniques 19.12 (Dec. 1971 [T-MTT] (1971 Symposium Issue)): 945-947.

Design techniques for high-performance microwave delay lines which have superior bandwidth, phase linearity, and spurious echo characteristics are presented. Utilization of these techniques to realize a 4-μs L-band unit which has insertion loss of 30 ±0.5 dB over the 500-MHz band centered at 1.7 GHz, with triple-transit suppression greater than 45 dB and phase deviation from linearity of less than ±2.5°, is described.

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The Ring-Loaded Corrugated Waveguide (Correspondence)

Y. Takeichi, T. Hashimoto and F. Takeda. "The Ring-Loaded Corrugated Waveguide (Correspondence)." 1971 Transactions on Microwave Theory and Techniques 19.12 (Dec. 1971 [T-MTT] (1971 Symposium Issue)): 947-950.

The ring-loaded corrugated waveguide is shown to be very effective for frequency broadbanding of the waveguide and improvement of the transformer between the corrugated and uncorrugated waveguides.

Abstracts

Controllable Liquid Artificial Dielectrics (Correspondence)

H.T. Buscher, R.M. McIntyre and S. Mikuteit. "Controllable Liquid Artificial Dielectrics (Correspondence)." 1971 Transactions on Microwave Theory and Techniques 19.12 (Dec. 1971 [T-MTT] (1971 Symposium Issue)): 950-951.

A novel approach to microwave phase control, utilizing liquid artificial dielectrics, is described. These media have been fabricated with permittivities which vary in magnitude and anistropy according to the strength of an applied electric control field. Continuously controlled permittivity increases of at least 20 percent in the electric field direction are realizable in liquid suspensions having low loss and very high dielectric strength. A simple waveguide liquid dielectric phase shifter has been built at Ku band and its operating characteristics measured. This approach can be applied to the design of electrically variable microwave lenses, power dividers, and resonant cavities as well as phase shifters.

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Scalar Finite-Element Program Package for Two-Dimensional Field Problems (Computer Program Descriptions)

A. Konrad and P. Silvester. "Scalar Finite-Element Program Package for Two-Dimensional Field Problems (Computer Program Descriptions)." 1971 Transactions on Microwave Theory and Techniques 19.12 (Dec. 1971 [T-MTT] (1971 Symposium Issue)): 952-954.

This program produces assembled finite-element matrices for solving scalar two-dimensional Laplace's, Poisson's, or Helmholtz's equations.

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Contributors (Dec. 1971 [T-MTT])

C.S. Aitchison, Y. Akaiwa, Y. Daido, R. Davies, I.D. Higgins, Y. Ito, H. Kawamoto, H. Komizo, S.R. Longley, M. Maeda, T. Meguro, S. Nagano, B.H. Newton, T.A. Saponas, W.G. Spaulding, A. Sumioka, I. Umebu, J.F. Wells and J.C. Williams. "Contributors (Dec. 1971 [T-MTT])." 1971 Transactions on Microwave Theory and Techniques 19.12 (Dec. 1971 [T-MTT] (1971 Symposium Issue)): 955-957.

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This index covers all items - papers, correspondence. reviews, etc. - that appeared in this periodical during 1971, and items from prior years that were commented upon or corrected m 1971. The index is divided into an Author Index and a Subject Index, both arranged alphabetically.

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Non-Minimum-Phase Microwave Filters (1968 [MWSYM])

T. Fjallbrant. "Non-Minimum-Phase Microwave Filters (1968 [MWSYM])." 1968 G-MTT International Microwave Symposium Digest and Technical Program 68.1 (1968 [MWSYM]): 1-7.

Ladder networks are particularly suitable for waveguide realizations. Conventional waveguide filters are designed by means of a transformation of lossless ladder networks terminated into resistances. This configuration, however, only allows the realization of a certain class of minimum-phase transfer functions. In this paper a type of microwave filter is analyzed, in which a reactive ladder is combined in a special way with a magic-T or 90-degree hybrid. This filter type can realize non-minimum phase functions, which can offer very useful combinations of amplitude and phase responses. The insertion loss of the ladder network does not enter the transfer function in the same way as in ordinary wave guide filters. A synthesis procedure is given, and this has been applied in the construction of several microwave filters. The inclusion of non-reciprocity by means of ferrite devices to realize fixed or variable filters or microwave modulators has also been studied. A similar method is applied in the realization of driving point impedances at microwave frequencies, in order to realize such functions as cannot normally be realized by means of ladder structures.

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Abstracts

Multi-Octave Bandwidth Microwave Mixer Circuits

R.C. Van Wagoner. "Multi-Octave Bandwidth Microwave Mixer Circuits." 1968 G-MTT International Microwave Symposium Digest and Technical Program 68.1 (1968 [MWSYM]): 8-15.

The bandwidth of many microwave systems has been steadily increased over the past few years. Log-periodic and spiral antennas are examples of radiators which have paced the bandwidth expansion drive. Wideband 3-db couplers and phase shifters have followed in close echelon. With the development of YIG filters, experimental local oscillators are now being developed that can be electronically swept over several octaves. All of these components are finding useful application in modern surveillance, tracking and electronic warfare systems.

Abstracts

A Wideband Stripline Matched Power Divider

P.C. Goodman. "A Wideband Stripline Matched Power Divider." 1968 G-MTT International Microwave Symposium Digest and Technical Program 68.1 (1968 [MWSYM]): 16-20.

In many microwave systems, a signal must be split into two equal-amplitude in-phase signals by a power divider. The power divider must be matched at the input to achieve complete power transfer and should, in most applications, be matched at the two output ports to avoid interaction between the power divider and mismatched networks connected to the outputs.

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The Calculation of TEM-, TE- and TM-Waves in Shielded Strip Transmission Lines

W. Baier. "The Calculation of TEM-, TE- and TM-Waves in Shielded Strip Transmission Lines." 1968 G-MTT International Microwave Symposium Digest and Technical Program 68.1 (1968 [MWSYM]): 21-31.

For the systematic development af new TEM-microwave components the accurate calculation of the TEM-wave characteristic impedance is necessary. Besides the characteristic impedance the properties af TE- and TM-modes in new configuratians are important. By TE- or TM-modes in a device designed for TEM-waves the function of this device is gravely disturbed. As the probability of TE- or TM-modes growths with frequency increasing this question is important especially at microwave frequencies.

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Analysis and Synthesis of Waveguide Multi-Aperture Directional Couplers (1968 [MWSYM])

R. Levy. "Analysis and Synthesis of Waveguide Multi-Aperture Directional Couplers (1968 [MWSYM])." 1968 G-MTT International Microwave Symposium Digest and Technical Program 68.1 (1968 [MWSYM]): 32-38.

The conventional treatment of directional couplers formed by two parallel waveguides coupled by a number of equally spaced discrete apertures is based on a loose coupling theory which, for co-directional couplers, assumes that the individual coupled voltages of the apertures add in the forward direction and tend to cancel in the backward direction. Assuming no multiple coupling or interaction effects, a first order expression for the isolation as a function of frequency and of the voltage amplitude couplings of the individual apertures is readily derived. These amplitudes may be tapered to give either Butterworth or Chebyshev performance and simple formulae for the amplitudes derived. In the case of fairly tightly coupled waveguides, e. g. 3 dB, it is preferable to use a set of superimposed arrays, which result in a shorter coupler since the majority of the holes in this design method are of equal diameter.

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An Investigation of Sharp Discontinuities in Rectangular Waveguides by Ray Theory

M.A.K. Hamid. "An Investigation of Sharp Discontinuities in Rectangular Waveguides by Ray Theory." 1968 G-MTT International Microwave Symposium Digest and Technical Program 68.1 (1968 [MWSYM]): 39-40.

Sharp lossless discontinuities in the walls of a rectangular waveguide operating in the dominant mode are commonly introduced for the sake of matching the waveguide to a given termination or for the transmission and distribution of microwave power. The presence of such discontinuities, however, gives rise to reflected waves and storage of reactive energy in the vicinity of the discontinuity because of the excitation of higher order evanescent waveguide modes. A reliable method for predicting the scattering coefficients at the plane of the discontinuity is naturally of great interest in the design or application of waveguide discontinuities.

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A New Finite-Difference Technique for Higher-Order Modes in Arbitrarily Shaped Waveguides

M.J. Beaubien and A. Wexler. "A New Finite-Difference Technique for Higher-Order Modes in Arbitrarily Shaped Waveguides." 1968 G-MTT International Microwave Symposium Digest and Technical Program 68.1 (1968 [MWSYM]): 41-45.

To design new waveguide shapes and to assess their performance in larger systems, propagation constants and field patterns must be found. The following examples are typical of studies requiring knowledge of higher-order modes: a) bandwidth considerations - the upper limit is set by the inception of higher-order modes; b) waveguide discontinuity analysis - a set of modes is required to solve scattering problems; and c) multimode launching and propagation studies - applications include prediction of undesirable linear accelerator resonances, multimode techniques in arial improvement, etc.

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Network Integration Approaches for Multiple-Diode High Power Microwave Generation

M.E. Hines. "Network Integration Approaches for Multiple-Diode High Power Microwave Generation." 1968 G-MTT International Microwave Symposium Digest and Technical Program 68.1 (1968 [MWSYM]): 46-53.

Rapid strides are now being made in solid-state microwave power generation, With the recent introduction of negative-resistance avalanche junction diodes and gallium arsenide bulk-effect devices, a new impetus was given to research. This paper is an attempt to assess the present status of these devices and to look into the future. Solid-state devices are already displacing vacuum tubes for low power system functions, including transmitters for line-of sight communication links. What are the possibilities that they can also replace high power microwave tubes? Here, we attempt to assess the probability of success and to foresee some of the directions which such research may take. We point out certain special problems to be solved and present new circuit concepts which appear promising at this time.

Abstracts

Power and Efficiency of IMPATT Oscillators

W.J. Evans and G.I. Haddad. "Power and Efficiency of IMPATT Oscillators." 1968 G-MTT International Microwave Symposium Digest and Technical Program 68.1 (1968 [MWSYM]): 54-62.

This paper presents results on r-f power output and efficiency of IMPATT oscillators obtained from a large-signal model of these devices. The Large-signal model is obtained by solving the nonlinear equations which relate the current and voltage in a Read-type IMPATT diode subject to the assumption that the transit time of the carriers through the drift region is small compared to the r-f period. The solution gives the current injected by the avalanche into the drift region as a function of the r-f voltage across the diode. From this result the external circuit current at the fundamental frequency of oscillation is found and is used to calculate the diode impedance. The results and conclusions which can be drawn from this analysis are summarized below.

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Circuit Techniques for the Noise Reduction and Frequency Stabilization of Avalanche Diode Oscillators

E.F. Scherer. "Circuit Techniques for the Noise Reduction and Frequency Stabilization of Avalanche Diode Oscillators." 1968 G-MTT International Microwave Symposium Digest and Technical Program 68.1 (1968 [MWSYM]): 63-71.

The noise performance of avalanche oscillators is limited by the inherent noisiness of the avalanche process. It is shown that by suitable system design and the use of noise reduction techniques the device limitations can be overcome in many applications.

Abstracts

Microwave Integrated IMPATT Diode Radiator

H.W. Cooper, C. Moskowitz, M.R. Natale and T. Andrews. "Microwave Integrated IMPATT Diode Radiator." 1968 G-MTT International Microwave Symposium Digest and Technical Program 68.1 (1968 [MWSYM]): 72-76.

Microwave integrated circuits, coupled with the capability of microwave power generation in bulk and junction semiconducting devices, have opened the possibility for constructing economical integrated beacons in which the entire package, including the prime power source, is of the order of a cubic inch. In order to realize the economy and efficiency inherent in these devices, it is necessary to abandon the concepts of distributed elements which have proved so useful in conventional propagating structures and adopt and develop instead means of determining the characteristics of extremely small integrated structures having generally low impedance levels characteristic of semi-conductor power generators. These techniques are described and developed for use in designing the integrated source-radiator. The device described in this paper consists of an X band dipole which is vapor deposited on an alumina substrate and integrally connected to an IMPATT oscillator thru an impedance transforming network together with an r. f. decoupled bias network.

Abstracts

Gunn Oscillator as a Frequency Memory Device

J. Magarshack. "Gunn Oscillator as a Frequency Memory Device." 1968 G-MTT International Microwave Symposium Digest and Technical Program 68.1 (1968 [MWSYM]): 77-90.

Microwave oscillators based on Gunn or avalanche effects are rapidly expanding the field of microwave applications with possibilities which are far in excess of the capabilities of more conventional sources. Some of these potential applications arise from the ability of these devices to combine several microwave operations in one single device. This paper describes such a property which has hitherto not been reported, namely the ability of a Gunn oscillator to oscillate stably at several predetermined frequencies and to switch from one frequency to another with very little residual oscillation at frequencies other than the selected one. The switching is performed either by a pilot oscillator or oscillators which synchronize the Gunn oscillator at a lower power level and which can be removed after switching, or if there are only two stable frequencies present, by sending a positive or negative going pulse along the bias. Experimental results will be given together with a qualitative explanation of the mechanism.

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Ultra-High Speed Diode Switch for 50 GHz Band Utilizing Avalanche Breakdown of Varactor Diodes (1968 [MWSYM])

S. Sugimoto. "Ultra-High Speed Diode Switch for 50 GHz Band Utilizing Avalanche Breakdown of Varactor Diodes (1968 [MWSYM])." 1968 G-MTT International Microwave Symposium Digest and Technical Program 68.1 (1968 [MWSYM]): 91-98.

This paper briefly reports on some of the results achieved with diode switches for 50 GHz band, which have been developed as transmitter-modulators for guided-millimeter-wave ultra-high-speed PCM communication systems.

Abstracts

Feed Back Stabilization and Noise Reduction in Solid State Multiplier Chains

C.L. Cuccia and A. Savarin. "Feed Back Stabilization and Noise Reduction in Solid State Multiplier Chains." 1968 G-MTT International Microwave Symposium Digest and Technical Program 68.1 (1968 [MWSYM]): 99-102.

Many papers have been written concerning the theory, design, techniques, and measurements relating to power sources consisting of chains of transistor oscillators and simplifiers and varactor multipliers. In general, these papers have emphasized circuit design and in particular, have made an emormous point of designing for optimum power conversion efficiency. However, attractive high efficiency may be from the device standpoint, power stability and low noise output are far more important parameters from the system standpoint in which the chain is used, to assure continuous spurious and noise free circuit operation, even at the sacrifice of output power.

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Recent Advances in Microwave Integrated Circuits

R. Webster. "Recent Advances in Microwave Integrated Circuits." 1968 G-MTT International Microwave Symposium Digest and Technical Program 68.1 (1968 [MWSYM]): 103-103.

A considerable effort has been expanded during the past few years on the development of integrated circuits for the microwave frequency range. The various integration techniques which are useful in this frequency range will be discussed and the advantages and disadvantages of each integration approach will be pointed out. Some examples of the state-of-the-art performance of various types of microwave integrated circuits will be given.

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Slot Line - An Alternative Transmission Medium for Integrated Circuits

S.B. Cohn. "Slot Line - An Alternative Transmission Medium for Integrated Circuits." 1968 G-MTT International Microwave Symposium Digest and Technical Program 68.1 (1968 [MWSYM]): 104-109.

Current development of microwave integrated circuits has revived interest in microstrip transmission line as a means of interconnecting solid-state elements into signal-processing subsystem. This paper describes an alternative kind of transmission line on a dielectric substrate that may be used with or instead of microstrip. As shown in Fig. 1, this alternative consists of a narrow slot or gap in a conductive coating on one side of the substrate. The other side of the substrate is exposed directly to air.

Abstracts

Frequency Dependent Behavior of Microstrip

C.P. Hartwig, D. Masse and R.A. Pucel. "Frequency Dependent Behavior of Microstrip." 1968 G-MTT International Microwave Symposium Digest and Technical Program 68.1 (1968 [MWSYM]): 110-116.

Recently there has been considerable interest in the use of the open microstrip geometry as a transmission line in microwave integrated circuits. This form of propagating structure is applicable to a monolithic approach on a semiconductor substrate as well as to a hybrid approach using a ceramic substrate. In order to choose suitable materials, we have investigated the basic properties of microstrip and its interactions with the substrate. A detailed experimental investigation has brought to light two important aspects of circuit design with microstrip. First, microstrip has an upper frequency limit and second, it is dispersive.

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Normal Mode Impedances of a Coupled Pair of Microstrip Transmission Lines

T.G. Bryant and J.A. Weiss. "Normal Mode Impedances of a Coupled Pair of Microstrip Transmission Lines." 1968 G-MTT International Microwave Symposium Digest and Technical Program 68.1 (1968 [MWSYM]): 117-122.

For guidance in the design of integrated microwave circuit components, data are required on the parameters of symmetrical coupled pairs of microstrip transmission lines. The parameters needed to characterize this structure are the characteristic impedances and velocities of propagation of the two normal modes. In addition, for certain purposes such as investigation of spurious coupling, peak power capability, and gyromagnetic interaction (in the case of nonreciprocal substrate material), information is also required on the r-f field configuration.

Abstracts

Analysis and Experimental Evaluation of Distributed Overlay Structures in Microwave Integrated Circuits

K.C. Wolters, P.L. Clar and C.W. Stiles. "Analysis and Experimental Evaluation of Distributed Overlay Structures in Microwave Integrated Circuits." 1968 G-MTT International Microwave Symposium Digest and Technical Program 68.1 (1968 [MWSYM]): 123-130.

Distributed microwave integrated circuits have in the past been fabricated by common etch-back techniques on metallized dielectric substrates resulting in simple microstrip transmission line structures for the passive circuitry. This paper discusses examples for the realization of improved circuit functions by overlaying dielectric and metallic films on the simple structure. The present discussion will be restricted to the passive part of hybrid integrated circuits, although analysis and techniques discussed here may also be useful for active devices and monolithics.

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X-Band Integrated Circuit Mixer with Reactively Terminated Image (1968 [MWSYM])

K.M. Johnson. "X-Band Integrated Circuit Mixer with Reactively Terminated Image (1968 [MWSYM])." 1968 G-MTT International Microwave Symposium Digest and Technical Program 68.1 (1968 [MWSYM]): 131-138.

The development of the Schottky barrier diode along with microwave integrated circuit techniques makes possible miniature high performance microwave detectors. This paper describes a low noise microwave integrated circuit mixer using Schottky barrier diodes and reactively terminated image with a 500 MHz thin film IF preamplifier. The entire mixer-IF preamplifier occupies an area of only 0.38 square inches and has a noise figure of 6.7 dB.

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An Integrated Microwave FM Discriminator

M.D. Bonfeld, M.J. Bonomi and E.G. Jaasma. "An Integrated Microwave FM Discriminator." 1968 G-MTT International Microwave Symposium Digest and Technical Program 68.1 (1968 [MWSYM]): 139-146.

Based on the recent advances in several technologies, a flurry of activity has been initiated in the field of microwave integrated circuits. Multifunction stripline circuits are now possible which compare favorably in quality with waveguide construction and offer the advantages of large reductions in cost and size. This paper shows the introduction of such microwave integrated circuit technology to an FM discriminator.

Abstracts

X Band Integrated Diode Phase Shifters

R.G. Stewart and M.N. Giuliano. "X Band Integrated Diode Phase Shifters." 1968 G-MTT International Microwave Symposium Digest and Technical Program 68.1 (1968 [MWSYM]): 147-154.

Recent advances in solid state microwave technology have made possible the fabrication of diode phase shifters in hybrid integrated circuit form. However, work at X band has been hindered by the limited isolation presently available with diodes at this frequency. Actually, accurate phase shifters can still be built if one accounts for this limited isolation in the design and analysis of the systems. This paper outlines this analysis and applies it in the design of low insertion loss phase shifters for wideband operation around 9 GHz. Surface oriented P/sup +/IN/sup +/ diodes are used in these switched line length systems to obtain phase shifts of up to 360°.

Abstracts

S-Band Integrated Parametric Amplifier Having both Flat Gain and Linear Phase Response

H.C. Okean and H. Weingart. "S-Band Integrated Parametric Amplifier Having both Flat Gain and Linear Phase Response." 1968 G-MTT International Microwave Symposium Digest and Technical Program 68.1 (1968 [MWSYM]): 155-163.

This paper describes the design of an integrated, S-band parametric amplifier that combines a new procedure for the simultaneous achievement of both flat gain and linear-phase response with integration of the essential amplifier components with respect to design and fabrication. Such integration, utilizing either printed-circuit or thin-film techniques, or both, and eliminating all the intercomponent connectors and superfluous transmission lines, lends itself to the realization of precise amplifier performance (reference 1), and leads to potential low cost, mass reproducibility.

Abstracts

A K/sub a/ Band Paramp Using Planar Varactors Yields a Noise Figure of Less Than 3 dB

L.E. Dickens. "A K/sub a/ Band Paramp Using Planar Varactors Yields a Noise Figure of Less Than 3 dB." 1968 G-MTT International Microwave Symposium Digest and Technical Program 68.1 (1968 [MWSYM]): 164-172.

A parametric amplifier has been developed which has given measured noise figures of under 3.0 dB while operating with a gain of 15 dB and an instantaneous signal bandwidth of greater than 600 MHz. The center frequency of operation is 31 GHz. It is a degenerate amplifier with the pump frequency of 62 GHz. The pump power actually being dissipated in the varactor is about 40 mW. A recently developed Schottky barrier varactor is being used in this amplifier. It has the planar structure in that the junction is defined by etching the appropriate sized hole through a SiO/sub 2/ layer on GaAs and then depositing the anode material in the holes. Anode contact is made by a spring wire, the length of which is selected to obtain the proper diode resonance. The cut-off frequency at the bias point is about 600 GHz.

Abstracts

A Technique for the Rapid Calculation of Distortion Effects in Varactor Parametric Amplifiers

D.R. Chambers and D.K. Adams. "A Technique for the Rapid Calculation of Distortion Effects in Varactor Parametric Amplifiers." 1968 G-MTT International Microwave Symposium Digest and Technical Program 68.1 (1968 [MWSYM]): 173-178.

Varactor parametric amplifiers (paramps) are useful for obtaining low-noise gain over relatively large bandwidths at microwave frequencies. Although usually intended for use where small signals are to be amplified, paramps often work in environments where large signals also exist. Therefore, multi-signal performance must be considered. As with other types of amplifiers, paramps exhibit distortion in the form of gain saturation, cross modulation, and intermodulation. Often, it is desirable to be able to predict, without lengthy calculations, the distortion performance of a paramp in advance, before committing a design to hardware. In addition, it is useful to be able to relate distortion performance directly to the specifications of the nonlinear element (varactor) so that distortion effects can be considered at the earliest possible stage in the design.

Abstracts

An Evaluation of Point Contact Tunnel Diodes as Microwave Circuit Elements

R.J. Taylor and C.R. Westgate. "An Evaluation of Point Contact Tunnel Diodes as Microwave Circuit Elements." 1968 G-MTT International Microwave Symposium Digest and Technical Program 68.1 (1968 [MWSYM]): 179-183.

The point contact geometry tunnel diode is recognized as an excellent low level detector. A recent analysis indicates that the tunnel diode, under certain conditions, has a figure of merit greater than any other known diode. In diodes designed for operation in the millimeter wave region, it is found that a number of factors arise which determine the performances of the devices that are not significant in diodes designed for the lower frequencies (less than 20 GHz). This paper reports some measurements carried out on point contact tunnel diodes in the millimeter wave region and evaluates the performances of these diodes in various applications.

Abstracts

The Transistor, a Microwave Filter Element

D.K. Adams and R.Y. Ho. "The Transistor, a Microwave Filter Element." 1968 G-MTT International Microwave Symposium Digest and Technical Program 68.1 (1968 [MWSYM]): 184-189.

Active filters offer a method for reducing the size of microwave filters without degrading performance. In addition, with active filters, network functions can be realized that are otherwise unrealizable. With the arrival of compact solid state techniques at microwave frequencies, the possibility for active microwave filters is emerging. Since transistors are one of the most likely components for active filter applications, it is of interest to see how microwave transistors can be used in filter applications. The purpose of this paper is to discuss several approaches to active microwave filters and to show examples of how transistor filters have been constructed.

Abstracts

Bulk Semiconductor Switches and Phase Shifters

K.E. Mortenson, J.F. White, A. Armstrong and J. Borrego. "Bulk Semiconductor Switches and Phase Shifters." 1968 G-MTT International Microwave Symposium Digest and Technical Program 68.1 (1968 [MWSYM]): 190-196.

Both switches and phase shifters using PIN diodes have great appeal to the designers of electronically steered, phased array antennas. With the PIN diode, conductivity modulation of the intrinsic region to a low resistance is effected under forward bias by the injection of carriers from the P+ and N+ contacts. An RF sinusoidal voltage applied across the diode terminals sees an unvarying resistance, because no appreciable net carrier drift occurs in the brief duration of half an RF cycle.

Abstracts

Microwave Phase Modulation Using Frequency Multipliers

A. Markovic, B. Schiek and H.-G. Unger. "Microwave Phase Modulation Using Frequency Multipliers." 1968 G-MTT International Microwave Symposium Digest and Technical Program 68.1 (1968 [MWSYM]): 197-208.

For communication by radio links, satellites, waveguides etc. a pulse code modulation that is realized by phase reversal (phase shift keyed) has advantages as compared to a pulse amplitude modulation because the signal-to-noise ratio can be 6 db less for the same error probability. The phase shift keying of the microwaves should be rapid (< 1ns) and the modulation losses should be small. A suitable semiconductor element for such a phase modulator is a voltage dependent capacitance diode. A simple circuit for a reflection type modulator is obtained when the diode terminates a transmission line. Then the phase of the reflected wave can be shifted by a change of the bias voltage. The lossless tuner in figure 1a is adjusted so that any residual amplitude modulation is minimized.

Abstracts

Operational S-Band Traveling-Wave Maser System in 15°K Closed-Cycle Refrigerator

J. Wolczok and J.G. Smith. "Operational S-Band Traveling-Wave Maser System in 15°K Closed-Cycle Refrigerator." 1968 G-MTT International Microwave Symposium Digest and Technical Program 68.1 (1968 [MWSYM]): 209-216.

The design of practical traveling-wave masers has, in the past, been limited to physical temperatures in the range of liquid helium (<= 5°K). The advantages of TWM operation at such low temperatures are manifold. All of the important operating characteristics of a TWM such as gain, instantaneous bandwidth, tuning bandwidth, effective noise temperature, etc. improve as the physical temperature is lowered. The consequence of such operation has been a sophisticated, large, and costly cryogenic system to provide the necessary environment.

Abstracts

Propagation in Longitudinally-Magnetized Ferrite Loaded Waveguide (1968 [MWSYM])

D.C. Buck. "Propagation in Longitudinally-Magnetized Ferrite Loaded Waveguide (1968 [MWSYM])." 1968 G-MTT International Microwave Symposium Digest and Technical Program 68.1 (1968 [MWSYM]): 217-227.

Longitudinally magnetized reciprocal ferrite phase shifters have shown anomalous behavior in that some devices show increasing phase shift with increasing applied field while others show decreasing phase shift with increasing applied field. This anomaly has been investigated theoretically by using a ferrite filled parallel plane guide model. It is shown that for electrically thin guides the phase shift decreases with applied magnetic field, whereas with increased thickness the phase shift becomes an increasing function of the applied field. The microwave electric and magnetic fields were calculated for various applied field values and reduced guide thicknesses. This showed that there are two competing mechanisms which govern the type of phase shift. These can be termed "μ- effective" and "faraday rotation." The latter sets in when the guide is thick enough to support a cross-polarized electric field of the same order of magnitude as the incident electric field. Similar analysis of the quasi-TE/sub 1/ and TM/sub 1/ modes were made, showing similar behavior at higher frequencies for a given guide thickness.

Abstracts

An Improved E-Plane Waveguide Circulator

M. Omori. "An Improved E-Plane Waveguide Circulator." 1968 G-MTT International Microwave Symposium Digest and Technical Program 68.1 (1968 [MWSYM]): 228-236.

This report describes the design and performance of an improved E-plane waveguide circulator. Although the E-plane circulator has the advantages of higher power operation and more compactness, it has received much less attention than its H-plane counterpart. This has probably been due to the difficulty of achieving broadband performance and the lack of adequate design information. It is proposed in this report that best performance occurs when the dimensions of the ferrite cylinder are adequate to support the fundamental cylindrical dielectric resonator mode. The junction dimensions are reduced to enhance the coupling of the incident energy to this dielectric resonator. At the junction, a novel approach is employed to convert the absorption type cavity to a transmission type. Reduced height transformers match the junction to the standard waveguide ports.

Abstracts

The Use of Composite Junctions in the Design of High Power Stripline Circulators

C.R. Buffler and J. Helszajn. "The Use of Composite Junctions in the Design of High Power Stripline Circulators." 1968 G-MTT International Microwave Symposium Digest and Technical Program 68.1 (1968 [MWSYM]): 237-247.

The concept of composite ferrite junctions has been in existence almost since the beginning of the ferrite device art. If a standard junction is defined as one in which the ferrite material itself fills the entire waveguide or stripline region between the metallic walls or ground planes, one then can then call a composite junction, any junction made up as a combination of ferrite and magnetically inactive dielectric materials, including air. An example of an early composite structure is the waveguide circulator design using a ferrite triangle sandwiched between two teflon sheets. The more recent concept in waveguide circulators of having two ferrite pieces, one on top and one on the bottom of the junction with an air dielectric separation is also an example of a composite junction. In this paper, we would like to show how an extension of these ideas leads one to a considerable improvement in the power handling capability of stripline junction circulators.

Abstracts

Recent Advances in Microstrip Circulators

V.E. Dunn and A.J. Domenico. "Recent Advances in Microstrip Circulators." 1968 G-MTT International Microwave Symposium Digest and Technical Program 68.1 (1968 [MWSYM]): 248-254.

The increasing interest in the use of microstrip on thin ceramic substrates for microwave integrated circuits has motivated the development of ferrite circulators compatible in size and geometry with this type of configuration. This paper describes several recent developments which reduce the size of microstrip circulators and make them more easily incorporated with microwave integrated circuits.

Abstracts

A Design Theory for Reggia-Spencer Reciprocal Ferrite Phase Shifters

W.E. Hord, F.J. Rosenbaum and C.R. Boyd. "A Design Theory for Reggia-Spencer Reciprocal Ferrite Phase Shifters." 1968 G-MTT International Microwave Symposium Digest and Technical Program 68.1 (1968 [MWSYM]): 255-263.

The Reggia-Spencer phase shifter consists of a ferrite bar or rod placed along the axis of a rectangular waveguide. When a longitudinal magnetic field is applied to the ferrite a change in the rf insertion phase is produced which is independent of the direction of the applied field and the direction of propagation. Although many phase shifters have been constructed using this principle, their design has proceeded empirically due to the lack of an adequate design theory. In 1966, Boyd suggested that the reciprocal phase shift could be explained in terms of a non-reciprocal coupling between two cross-polarized waveguide modes, one the TE/sub 10/-like dominant mode supported by the inhomogeneously filled waveguide, the other a cross-polarized mode which is normally cut off. If this mode propagates Faraday rotation can occur.

Abstracts

A 500 kW X-Band Air-Cooled Ferrite Latching Switch (1968 [MWSYM])

R.A. Stern and J.P. Agrios. "A 500 kW X-Band Air-Cooled Ferrite Latching Switch (1968 [MWSYM])." 1968 G-MTT International Microwave Symposium Digest and Technical Program 68.1 (1968 [MWSYM]): 1034-1037.

This paper describes the development of a high peak and average power X-band latching SPDT switch for use in antenna switching or energy transfer s wit thing applications. The switch is capable of handling 500 k W peak and 666 W average power levels with external forced air cooling. It is of the differential phase shift circulator type employing a folded magic T, a short slot hybrid and two nonreciprocal 90° ferrite latching phase shifters in RG-51/U waveguide.

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Abstracts

A Waveguide Reciprocal Latching Ferrite Phase Shifter

I. Bardash and J.J. Maune. "A Waveguide Reciprocal Latching Ferrite Phase Shifter." 1968 G-MTT International Microwave Symposium Digest and Technical Program 68.1 (1968 [MWSYM]): 274-281.

The development of the non-reciprocal latching ferrite phase shifter may be considered to be one of the major factors in the realization of phased array radar systems. Its non-reciprocal characteristics however make it impractical for use with certain systems such as high p.r.f. and short range radars. A waveguide reciprocal latching ferrite phase shifter has been developed for use at C-band and X-band frequencies which has many of the attractive properties of its predecessor plus reciprocity. Several types of reciprocal latching ferrite phase shifters have been built in the past. The one that will be described here consiets of a longitudinally magnetized ferrite double toroid centrally located in waveguide. Low loss, low reflection operation is achieved by utilizing flux-transfer magnetization and relying on the minor hysteresis remnant properties of the ferrite for maintaining the applied phase settings.

Abstracts

Magnetically Tunable Microstrip Filter Structures

R.R. Jones, J. Cunningham and K. Bullock. "Magnetically Tunable Microstrip Filter Structures." 1968 G-MTT International Microwave Symposium Digest and Technical Program 68.1 (1968 [MWSYM]): 282-290.

Tunable filter structures are indispensables preselectors in such systems as ECM receivers and telemetry converters. These new integrated circuit filter structures have a number of distinct advantages over the single crystal YIG preselectors, although the tunable frequency range of the planar devices have not exceeded a half octave.

Abstracts

Ultrasonic Waveguide Systems for Surface Waves

D.L. White. "Ultrasonic Waveguide Systems for Surface Waves." 1968 G-MTT International Microwave Symposium Digest and Technical Program 68.1 (1968 [MWSYM]): 291-291.

Wave guides for Rayleigh surface waves have been made by depositing thin strips of gold plating on a fused quartz substrate. (Rayleigh waves propagate on the surface of a solid in a mariner similar to water waves on a liquid). The principle of guidance is a property common to all wave systems, sonic as well as electromagnetic - a wave will be guided along the axis of a perturbing strip if the net phase velocity in the presence of the strip is lower than that of the uniform medium. Thus the electromagnetic equivalent of this guidance system is microwave dielectric waveguides and fiber optics rather than metal tubes. A complete system of ultrasonic circuitry can be constructed which performs the functions normally expected of waveguides. Experiments were performed in the 10 to 35 MHz range because the ultrasonic transducer art is well developed at that frequency and because the wavelength of sound would be large enough to examine the distribution of energy in the waveguides with probes on micromanipulators. The gold strips are about a hundredth of a wavelength thick and several tenths of a wavelength in width, The dispersion curve for the lowest guided mode has been determined and found to accurately agree with theory. The Q of the transmission lines have been over 5000 and waves have been guided around bends with very low loss. A number of elements such as power dividers, directional couplers and resonators have been made by plating different patterns on the substrate.

Abstracts

State of the Art in Microwave Acoustic Delay Devices

W.A. Crofut. "State of the Art in Microwave Acoustic Delay Devices." 1968 G-MTT International Microwave Symposium Digest and Technical Program 68.1 (1968 [MWSYM]): 292-300.

This paper will discuss the state of the art of several types of microwave acoustic delay devices and although it will concentrate mostly in the L and S band frequencies much of the content is appropriate to frequencies as high as X band. The devices to be considered are non-dispersive delay lines, acousto-optical modulators, and dispersive delay devices. In general these devices use either magnetoelastic and magnetostatic propagation in ferromagnetic crystals such as yttrium iron garnet or pure acoustic propagation in a large variety of single crystal materials.

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Performance of Ultra-Bandwidth YIG Pulse Compression Networks

W.L. Bongianni, J. Burnsweig and J.H. Polson. "Performance of Ultra-Bandwidth YIG Pulse Compression Networks." 1968 G-MTT International Microwave Symposium Digest and Technical Program 68.1 (1968 [MWSYM]): 301-308.

Advanced radar signal processing techniques for improved target detection in severe clutter environments require large pulse compression bandwidths. The clutter power returned from a ground path is proportional to the illuminating pulsewidth. Narrow pulsewidths, possible with pulse compression without sacrifice in average power, provide an excellent way of improving detectability through reduction of clutter return. Frequency diversity is another technique frequently employed to improve the detectabdlty of targets obscured in a clutter environment. Here, again, employment of an ultra-bandwidth spectrum provides the same effect with the complexity of a frequency diversity transmitter-receiver unit. The effect of the broad band spectrum is to cause the target and the clutter statistics to be altered such that a lower threshold can be set for improving target detections. The ultra-bandwidth performance obtained with the single crystal YIG dispersive delay line places it in the front rank of promising candidates for high resolution applications.

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Birefringent Filter for Millimeter Waves (1968 [MWSYM])

B.M. Schiffman and L. Young. "Birefringent Filter for Millimeter Waves (1968 [MWSYM])." 1968 G-MTT International Microwave Symposium Digest and Technical Program 68.1 (1968 [MWSYM]): 309-316.

The theory of optical birefringent filters consisting of several equal-length birefringent plates oriented at various angles to the input polarization vector has been applied to millimeter waves. Each plate of such a filter should be ideally impedance-matched to free space, and the wave to be filtered should be a linearly polarized plane wave. The filter, in effect, rotates the plane of polarization of a band of frequencies that it is desired to pass (stop), and permits the undesired (desired) frequencies to travel on unrotated. Polarization-selective absorbers are thus required. The input and output wave vectors are usually either orthogonal or parallel to each other.

Abstracts

Low-Pass, Quasi-Optical Filters for Oversized or Focused-Beam Waveguide Applications (1968 [MWSYM])

G.L. Matthaei and D.A. Leedom. "Low-Pass, Quasi-Optical Filters for Oversized or Focused-Beam Waveguide Applications (1968 [MWSYM])." 1968 G-MTT International Microwave Symposium Digest and Technical Program 68.1 (1968 [MWSYM]): 317-323.

At this time there is increasing interest in microwave and millimeter-wave systems which use quasi-optical propagation. Examples are focused-beam waveguides and oversized metal waveguides, both of which permit high power carrying capability and low transmission losses. To date most of the research on filters for such systems has been based on the use of dielectric layers of differing dielectric constants. This paper describes a new type of low-pass structure capable of a broad stop band such as would be required in many practical quasi-optical systems. This structure is similar in some respects to the artificial dielectric structures used in some lens antennas.

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Plane Waveguide Mode Effects in the Visible Spectrum

R. Shubert and J.H. Harris. "Plane Waveguide Mode Effects in the Visible Spectrum." 1968 G-MTT International Microwave Symposium Digest and Technical Program 68.1 (1968 [MWSYM]): 324-330.

This paper describes waveguide modes and mode interactions that have been observed on thin films in the visible spectrum. The modes are similar to parallel plate waveguide modes. Through mode interference, a wide variety of aperture distributions across the edge of the film has been produced. Integration of dielectric devices into the film structure is under investigation for future use in design of optical networks.

Abstracts

Dielectric Waveguide for Infrared Wavelengths

D.B. Anderson and C.B. Shaw, Jr.. "Dielectric Waveguide for Infrared Wavelengths." 1968 G-MTT International Microwave Symposium Digest and Technical Program 68.1 (1968 [MWSYM]): 331-341.

The microphotolithographic art, together with thin films and heteroepitaxial crystals of the semiconductor integrated circuit technology, has been used to define a variety of dielectric waveguide structures other than fibres which are useful in the infrared region. The transverse dimensions of these dielectric infrared waveguides are comparable to the wavelength so that control of the polarization, kind and order bounded modes may be exercised. Therefore, these structures are described as a "quasi-microwave" approach for optical waveguide.

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Foreword (1969 [MWSYM])

J.C. Sadler and B.R. Hallford. "Foreword (1969 [MWSYM])." 1969 G-MTT International Microwave Symposium Digest of Technical Papers 69.1 (1969 [MWSYM]): iii-iii.

The Dallas G-MTT Chapter extends a cordial welcome to all of you attending the 1969 IEEE G-MTT International Microwave Symposium. This year's technical program has been greatly expanded to provide broader coverage in the field of microwave theory and techniques. To have time for the many fine papers submitted this year, it was necessary to have concurrent sessions for the full three day period. In addition, three panel discussions are scheduled for the first evening.

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Introductory Session, 1969 G-MTT International Microwave Symposium

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Wave Propagation in Microstrip Transmission Lines

G.I. Zysman and D. Varon. "Wave Propagation in Microstrip Transmission Lines." 1969 G-MTT International Microwave Symposium Digest of Technical Papers 69.1 (1969 [MWSYM]): 3-9.

With the growing popularity of integrated circuits the microstrip transmission line has received wide attention from the microwave community. A common feature that most known analytic solutions share is an assumption that the fundamental mode of propagation resembles a TEM wave closely enough to permit various electrostatic approximations such as conformal mapping, relaxation method, and variational principle. Such solutions although quite useful at low frequencies neglect the fact that the actual propagating modes cannot be TEM. The dispersion of non-TEM waves causes, at microwave frequencies, considerable deviations in effective dielectric constant and velocity of propagation from those values obtained by the electrostatic approximation. In this paper it is shown that the modes that exist on a microstrip transmission line must be hybrid in order that all boundary and continuity conditions be satisfied. In this rigorous analysis the hybrid modes are decomposed into sums of TE and TM (or LSE and LSM) space harmonics, each satisfying the wave equation and the external boundary conditions and their total satisfying the continuity conditions and boundary conditions on the strip. The final outcome of the analysis is a pair of coupled integral equations that are solved numerically. The results indicate that the fundamental hybrid mode is propagating at all frequencies and approaches the known static solutions at low frequencies. However, the correct solution deviates from the static approximation at microwave frequencies. Of particular interest is the fact that as the dielectric constant of the substrate increases the frequency range at which the TEM approximation is valid decreases. The results obtained show close agreement with available experimental data.

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Interdigitated Strip-Line Quadrature Hybrid

J. Lange. "Interdigitated Strip-Line Quadrature Hybrid." 1969 G-MTT International Microwave Symposium Digest of Technical Papers 69.1 (1969 [MWSYM]): 10-13.

Hybrids are frequently used as components in microwave systems or sub-systems such as balanced mixers, balanced amplifiers, phase shifters, attenuators, modulators, discriminators, measurement bridges, etc. An ideal hybrid is a four-port junction with properties such that a wave incident in port one couples equal power into ports two and four but none into port three. Hybrids are classified according to the phase shift between the two outputs. There are two basic types: 180° hybrids and 90° (quadrature) hybrids. The latter are also called 3-dB directional couplers.

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Filtering, Frequency Multiplexing, and Other Microwave Applications with Inverted-Common-Collector Transistor Circuits

D.K. Adams and R.Y.C. Ho. "Filtering, Frequency Multiplexing, and Other Microwave Applications with Inverted-Common-Collector Transistor Circuits." 1969 G-MTT International Microwave Symposium Digest of Technical Papers 69.1 (1969 [MWSYM]): 14-20.

To be useful in the design of microwave integrated circuits, conventional components often need to be severely modified or to be employed in other than the usual configurations. The inverted-common-collector (ICC) transistor is an example of a useful active microwave circuit element, suitable for integrated-circuit applications, but virtually unused at lower frequencies. Initial results on active filters using ICC transistors were reported at the 1968 G-MTT symposium. More recently, the ICC configuration has been successfully used to realize stable multiplexers, impedance-matching elements, oscillators, and amplifiers at UHF and microwave frequencies. The purpose of this paper is to present several new applications for ICC transistor circuits.

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A 3:1 Bandwidth Low Noise Mixer

R.E. Blight. "A 3:1 Bandwidth Low Noise Mixer." 1969 G-MTT International Microwave Symposium Digest of Technical Papers 69.1 (1969 [MWSYM]): 21-25.

The microstrip mixer shown in Fig. (1) is a broadband design based on an impedance match concept at the local oscillator drive level. It covers the frequency band 3.5-10.5 GHz. A simple balanced mixer design consists of three basic components - a 3 dB coupler, band rejection filter and a matched diode.

Abstracts

A Hybrid Integrated L-Band Digital Phase Shifter

R.F. Lee and K.F. Sodomsky. "A Hybrid Integrated L-Band Digital Phase Shifter." 1969 G-MTT International Microwave Symposium Digest of Technical Papers 69.1 (1969 [MWSYM]): 26-30.

This paper presents a description of an L-band dual-channel seven-bit phase shifter which has been developed for a phased-array application. Each channel provides seven-bit phase shifting capability over a 360° range in 2.8° increments. The outputs from the two channels are summed in a combiner which has also been integrated into the overall assembly. The performance requirements for the assembly are as follows: Bandwidth 15%, RMS deviation from nominal phase <= 3.5°, RMS deviation from mean loss <= 0.35 dB, Return loss at each port >= 17 dB. Since this unit would be utilized in large numbers in its intended application and since there are a large number of phase states, it was advantageous to define the unit-to-unit similarity in terms of RMS deviations rather than peak-to-peak limits.

Abstracts

4GHz Multi-Stage Transistor Amplifier

K. Ayaki, E. Igarashi and Y. Kajiwara. "4GHz Multi-Stage Transistor Amplifier." 1969 G-MTT International Microwave Symposium Digest of Technical Papers 69.1 (1969 [MWSYM]): 31-36.

Early microwave transistor amplifiers were single-transistor-cascaded types. They needed numerous tuning adjustments in order to obtain wide-band flat gain characteristics. To overcome the difficulty, a balanced transistor amplifler was developed. However, it requires a second transistor at every stage and its circuit is complicated. This fact gives rise to high cost. In this paper the design principle and experimental results of a multistage transistor amplifier of simple construction are described. In this amplifier, n unit amplifiers of the same design are connected in cascade. Short transmission lines are inserted between each amplifiers. The n-stage amplifler gives a gain n times that of the unit amplifier, and it has 900~1,000 MHz of flat bandwidth in 4 GHz band.

Abstracts

Session MAM-II -- Precision Measurements and Components

"Session MAM-II -- Precision Measurements and Components." 1969 G-MTT International Microwave Symposium Digest of Technical Papers 69.1 (1969 [MWSYM]): 37-37.

Abstracts

Measurements on the Properties of Microwave Integrated Circuits

M. Caulton, B. Hershenov, S.P. Knight and L.S. Napoli. "Measurements on the Properties of Microwave Integrated Circuits." 1969 G-MTT International Microwave Symposium Digest of Technical Papers 69.1 (1969 [MWSYM]): 38-44.

Microwave integrated circuits (MIC) using low-impedance high-power devices demand high-Q components. In addition, MIC using both lumped and distributed (microstrip) elements are finding applications at frequencies well above S-band. It is the purpose of this paper to describe some recent measurements on circuit properties consisting of: (1) the reactance and Q of lumped-elements at frequencies above S-band, and (2) the dispersive characteristics of microstrip transmission lines.

Abstracts

Dependence of Stripline Performance on Dielectric Properties and Packaging Techniques

J.H. Ball, M. Olyphant and L.K. VanDover. "Dependence of Stripline Performance on Dielectric Properties and Packaging Techniques." 1969 G-MTT International Microwave Symposium Digest of Technical Papers 69.1 (1969 [MWSYM]): 45-52.

When stripline circuits fail to meet performance goals the cause is likely to be mechanical in the case of homogeneous dielectrics and electrical in the case of reinforced materials. Dimensional instability and/or crazing tendencies are intrinsic in pure polymars, whereas the electrical problems encountered with reinforced materials are caused largely by misunderstanding of dielectric behavior and inadequate control of dielectric properties. The latter deficiencies are correctable. This paper describes a study of stripline dielectric properties of glass-cloth reinforced TFE (fluorocarbon) which has been carried out to: 1) Devise a simple and precise test for strip line dielectric constant and loss tangent. 2) Determine the mean dielectric constant and production limits of various copper clad constructions. 3) Measure the effect of clamping pressure on apparent dielectric constant. 4) Determine the effectiveness of a bonding film between layers as a means of eliminating the pressure effect.

Abstracts

Techniques for Determining the Microwave Properties of Thermally Degraded Spacecraft Heat Shield Materials

M.C. Gilreath, W.F. Croswell and J.E. Jones. "Techniques for Determining the Microwave Properties of Thermally Degraded Spacecraft Heat Shield Materials." 1969 G-MTT International Microwave Symposium Digest of Technical Papers 69.1 (1969 [MWSYM]): 53-58.

Techniques for determining the microwave properties of spacecraft thermal protection materials, such as subliming ablators, charring ablators, etc., under various thermal conditions are presented. Room temperature dielectric constants and loss tangents of the materials are obtained at several frequencies using standard cavity methods. High temperature dielectric properties can be inferred from real time transmission loss measurements in an arc tunnel. The dielectric properties of cold thermally degraded materials are inferred from transmission measurements in an arc tunnel and on an antenna pattern range. An independent determination of the dielectric properties of thermally degraded materials was obtained by comparing aperture admittance measurements of a ground-plane mounted rectangular waveguide, under the ablation material, with aperture admittance calculations assuming various inhomogeneous dielectric properties. Also included, for comparison, are calculations assuming the conducting char layer is replaced by a perfectly conducting metal sheet.

Abstracts

The Rotary Slot Attenuator

F.S. Coale and W.L. Wallick. "The Rotary Slot Attenuator." 1969 G-MTT International Microwave Symposium Digest of Technical Papers 69.1 (1969 [MWSYM]): 59-67.

A new precision waveguide attenuator is presented which is the dual of the rotary vane attenuator. The device consists of rectangular to circular waveguide transitions coupled to a section of circular waveguide containing a pair of longitudinal slots. The entire circular section may be rotated so as to couple varying amounts of microwave energy into external loads. The attenuation produced varies as 20 log Cos^2 theta where theta is angle of the slots with respect to the incident electric field. Since the absorbing material is external to the circular guide, this device is suitable for high power applications. The theoretical analysis is based on the equivalence of rectangular and circular waveguides insofar as slot coupling is concerned. The attenuation per unit length is derived and compared to the experimental results. A unit has been constructed which dissipates 10 KW average power and 100 KW peak power in the 2.6 - 3.95 GHz frequency band. The input VSWR was less than 1.15 through all values of attenuation and the insertion loss was less than 0.1 dB. The maximum value of attenuation was greater than 50 dB. Other units are described which were designed in the X- Band and Ku- Band frequency ranges.

Abstracts

Nanosecond Measurement of Microwave Reflection Coefficients and Properties of Materials

R.S. Hawke. "Nanosecond Measurement of Microwave Reflection Coefficients and Properties of Materials." 1969 G-MTT International Microwave Symposium Digest of Technical Papers 69.1 (1969 [MWSYM]): 68-69.

This paper presents a technique of measuring the change in the microwave reflection coefficient and Hall rotation angle while an exploslve-generated, high-pressure shock wave propagates through a dielectric or semiconductor material in a magnetic field. With this technique, the permittivity, conductivity, and Hall coefficient can be calculated. The technique is widely applicable to measurement of fast changes (10 nanoseconds) in microwave properties; furthermore, the principles are adaptable to lower and higher frequency measurements.

Abstracts

Computer-Aided Microwave Impedance Measurements (1969 [MWSYM])

J.E. Dalley. "Computer-Aided Microwave Impedance Measurements (1969 [MWSYM])." 1969 G-MTT International Microwave Symposium Digest of Technical Papers 69.1 (1969 [MWSYM]): 70-75.

The development of better microwave components has made it possible to design more sophisticated systems in the last decade. Great strides have also been made in creating new and better microwave semiconductor devices. In order to adequately characterize these new components and systems, accurate impedance measurements are required at many frequencies. Several manufacturers have recently introduced network analyzers which are capable of providing magnitude and phase information which can be read directly from panel meters. External connectors are provided for analog-to-digital conversion of the data. While these network analyzers are convenient to use, their accuracy is often not as high as desired due to impairment by system imperfections such as coupler directivity and reflections from small discontinuities. This paper discusses the use of a general purpose digital computer to remove the system errors from microwave impedance measurements while the measured data are being converted to a variety of forms useful for circuit design or device evaluation. Error reduction is accomplished by using the known values and the measured values of three reference impedances to form a matrix. The corrected impedance can then be found from the measured impedance by the use of matrix algebra.

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Abstracts

Session MPM-I -- Ferrite Components

"Session MPM-I -- Ferrite Components." 1969 G-MTT International Microwave Symposium Digest of Technical Papers 69.1 (1969 [MWSYM]): 76-76.

Abstracts

Four-Port YIG Filter

J.C. Hoover and R.E. Tokheim. "Four-Port YIG Filter." 1969 G-MTT International Microwave Symposium Digest of Technical Papers 69.1 (1969 [MWSYM]): 77-82.

The four-port YIG filter represents a new class of multifunction YIG components. This device, by proper coupling techniques, yields a reciprocal and tunable YIG filter with balanced outputs and two inputs. One input is coupled through the YIG resonator and is delivered as two equal amplitudes, 180 degrees out-of-phase signals at the balanced outputs. This signal, as it is coupled through the YIG, has a bandpass characteristic. The second input does not couple to the YIG but is split in-phase between the balanced outputs. The transmission of this signal does not involve the YIG resonance. The component thus combines the function of a tunable bandpass filter and a 180 degree hybrid junction, and so may be accordingly used. Experimental devices were built and evaluated as a combined preselector and balanced mixer, in particular, in regard to subharmonic mixing for multioctave performance. Also, the same device was evaluated as a tunable phase discriminator showing the versatility of this new component. Subharmonic mixing was evaluated using the four-port filter from 2.0 to 8.0 GHz while the discriminator, as breadboarded, was found to tune from 1.0 to 5.0 GHz with decade performance clearly feasible.

Abstracts

VHF- and UHF-Band Stacked-Junction Circulators

S. Okamura and T. Nagai. "VHF- and UHF-Band Stacked-Junction Circulators." 1969 G-MTT International Microwave Symposium Digest of Technical Papers 69.1 (1969 [MWSYM]): 83-87.

A new type of junction circulators, in which two ordinary ferrite-loaded junctions are stacked and assembled in a common housing, is presented. The input power is divided into two junctions and the C W power rating doubled. The stacked circulator increases the freedom to choose the ferrite size, which must be optimized for a specific power level in each application because it affects closely the cost of the assembled circulator, and this design was proved to be very effective in improving the cost/power performance.

Abstracts

A Low-Cost Latching Ferrite Phaser Fabrication Technique

D.H. Temme, R.L. Huntt, R.G. West and A.C. Blankenship. "A Low-Cost Latching Ferrite Phaser Fabrication Technique." 1969 G-MTT International Microwave Symposium Digest of Technical Papers 69.1 (1969 [MWSYM]): 88-96.

The electrical characteristics of latching ferrite waveguide phasers have been fairly well established, and increased attention is currently directed towards fabrication simplicity to reduce cost. Construction techniques considered in this paper permit the use of loosely toleranced ceramic and metal parts without sacrificing electrical and thermal performance of the phaser. An integral consideration is the degree that the flux-drive technique allows the relaxation of mechanical and ferrite material parameter tolerances.

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Abstracts

Review of Planar Ferrite Devices

G.P. Rodrigue. "Review of Planar Ferrite Devices." 1969 G-MTT International Microwave Symposium Digest of Technical Papers 69.1 (1969 [MWSYM]): 97-98.

Major emphasis in the microwave components area today is on economy. In the early pioneering days of microwave development, performance was the criterion of excellence, and cost played a very subordinate role. Microwave components have traditionally been state-of-the-art devices, almost hand-tailored units with relatively small production runs. The increasing application of microwaves to communications systems, a growing urge to invade consumer markets, and the advent of electronically scanned arrays have all underscored a need for more economical (even cheap!) microwave devices. This trend is associated not only with a tightened federal R & D dollar, but also with a maturing industry, Today it is not so much a question of whether or not a circuit function can be done, but can it be done economically. Increasingly, the tradeoffs between cost and performance are being exhaustively studied.

Abstracts

Measurement of Slot Line Characteristics

E. Mariani, C. Heinzman, J. Agrios and S.B. Cohn. "Measurement of Slot Line Characteristics." 1969 G-MTT International Microwave Symposium Digest of Technical Papers 69.1 (1969 [MWSYM]): 99-105.

The development of micrcwave integrated circuits has effected considerable interest in microstrip transmission lines on dielectric substrates. This paper discusses the slot line, a novel transmission line that may be used in association with, or as an alternative to microstrip. Slot line consists of a narrow slot in a thin conductive layer on one side of a high permittivity dielectric substrate; the other side is bare as shown in Fig. 1. The slot line offers some important advantages when compared to microstrip by virtue of the slot-made configuration, Fig. 2. The electric field is across the slot while the magnetic field is perpendicular to the slot and forms closed loops at half-wave intervals. Thus, the slot line possesses a region of elliptical polarization which should be useful for constructing a variety of non-reciprocal, ferrite, slot line devices such as resonance isolators, latching phase shifters, and circulators. Since the slot mode's voltage occurs across the slot on one side of the substrate, it is especially convenient for connecting shunt elements such as diodes, resistors and capacitors. Moreover, the same manufacturing techniques used for microstrip integrated circuits can be applied to slot line.

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Application of Slot Line to Miniature Ferrite Devices

G.H. Robinson and J.L. Allen. "Application of Slot Line to Miniature Ferrite Devices." 1969 G-MTT International Microwave Symposium Digest of Technical Papers 69.1 (1969 [MWSYM]): 106-109.

Slot transmission line was introduced by S. B. Cohn in 1968 as an alternative transmission line for microminiature components. Slot line is potentially advantageous when compared to other planar transmission lines for applications requiring regions of circularly polarized magnetic field and/or shunt mounted elements. The line consists of two conductors separated by a gap on one side of a dielectric substrate. The dominant mode is a TE mode as shown in Figure 1. This mode resembles the dominant mode of rectangular waveguide and provides natural regions of circularly polarized magnetic field. Slot line applications will include ferrite phasers, circulators and isolators, diode switches and phasers, and filters. Combined microstrip and slot line circuitry seem to offer new possibilities for systems with the advantage of coupling easily through the substrate from one medium to the other.

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Coplanar Waveguide, A Surface Strip Transmission Line Suitable for Nonreciprocal Gyromagnetic Device Applications (1969 [MWSYM])

C.P. Wen. "Coplanar Waveguide, A Surface Strip Transmission Line Suitable for Nonreciprocal Gyromagnetic Device Applications (1969 [MWSYM])." 1969 G-MTT International Microwave Symposium Digest of Technical Papers 69.1 (1969 [MWSYM]): 110-115.

A novel integrated circuit transmission line with all conducting elements on the same side of a dielectric substrate (coplanar waveguide) has been demonstrated as a suitable structure for fabricating nonreciprocal microwave magnetic devices. As shown in Figure 1, the coplanar waveguide (CPW), consists of a strip of thin metallic film deposited on the surface of a dielectric slab with two ground electrodes running adjacent and parallel to the strip on the same surface. The r-f electric field between the center conductor and the ground electrodes tangential to the air-dielectric boundary produces a discontinuity in displacement-current density at the interface, thus giving rise to an axial as well as transverse component of r-f magnetic field shown in Figure 2. These r-f magnetic field components provide the elliptical polarization needed for nonreciprocal gyromagnetic devices. The coplanar configuration of the conducting elements permits easy connection of external shunt elements such as active devices in hybrid integrated circuits. It is also ideal for shunt connection of various elements in monolithic microwave integrated circuit systems.

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Abstracts

A Thin Film Lumped Element Circulator

R.H. Knerr. "A Thin Film Lumped Element Circulator." 1969 G-MTT International Microwave Symposium Digest of Technical Papers 69.1 (1969 [MWSYM]): 116-121.

The lumped element circulator has been treated analytically and several lumped element circulators have been described. Recent advances in thin film technology such as the thin film crossover as developed by J. P. Sitarik (BTL) who used photo-resist as the insulating layer at the crossover point and more recently the air crossover by Martin P. Lepselter (BTL) offer new design possibilities for lumped element circulators which decrease their size, increase the possibility of integration and extend the range of feasibility from L-band up into the higher regions of the microwave spectrum.

Abstracts

An Investigation of Six-Port Phase-Type Circulators and Switches

A.I. Gherm, Y.P. Kasianov and N.V. Slavin. "An Investigation of Six-Port Phase-Type Circulators and Switches." 1969 G-MTT International Microwave Symposium Digest of Technical Papers 69.1 (1969 [MWSYM]): 122-129.

A wide variety of ferrite circulator and switches is being used in UHF channels of current wireless systems. Theory of three- and four-port circulators and switches has reached a fairly advanced development stage. Appropriate devices in our country and elsewhere have parameters that are pretty close to the maximum attainable. Nevertheless, the problems concerning the improvement of electric strength and reduction of losses continue to be topical. They are especially urgent when operational peculiarities of the system call for a considerable number of such devices. The currently known junction patterns for several circulators, though lending considerable operational possibilities, are on the other hand not optimal from the point of view of electric strength (each circulator carries full power) and losses (the circulator losses are added). Increase in the number of circulators or switches also leads to reduction of reliability of the set as a whole. Therefore it is but natural to attempt a combination of functions of a number of circulators (switches) in a single device. This paper deals with six-port devices permitting an increase of electric strength as well as reduction of losses.

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Session MPM-II -- Solid-State Circuits and Devices

"Session MPM-II -- Solid-State Circuits and Devices." 1969 G-MTT International Microwave Symposium Digest of Technical Papers 69.1 (1969 [MWSYM]): 130-130.

Abstracts

A New Technique for Designing Highly Stable High Efficiency Varactor Multiplier Chains

A.I. Grayzel and R.T. Minkoff. "A New Technique for Designing Highly Stable High Efficiency Varactor Multiplier Chains." 1969 G-MTT International Microwave Symposium Digest of Technical Papers 69.1 (1969 [MWSYM]): 131-135.

In designing varactor multiplier chains, it is normally necessary to include isolators between the multipliers in order to eliminate spurious signals which are due to parametric oscillations. These oscillations can occur when two adjacent multipliers are not perfectly matched. In this paper, we shall present a method for the design of multiplier chains which are highly stable, eliminating the need for isolators.

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Abstracts

The Design of Broadband Frequency Doublers Using Charge-Storage Diodes (1969 [MWSYM])

K.L. Kotzebue and G.L. Matthaei. "The Design of Broadband Frequency Doublers Using Charge-Storage Diodes (1969 [MWSYM])." 1969 G-MTT International Microwave Symposium Digest of Technical Papers 69.1 (1969 [MWSYM]): 136-142.

With varying degrees of approximation, the parametric action in many frequency multipliers can be viewed as the coupling of impedances at different frequencies by means of an impedance inverter. One such multiplier which can be so characterized is the charge-storage multiplier without idlers. In the equivalent circuit for such a multiplier, as shown in Fig. 1, the time-varying action of the diode is represented by the impedance inverter marked K.

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Abstracts

A Study of High Power Pulsed LSA GaAs Devices

B.I. Jeppsson. "A Study of High Power Pulsed LSA GaAs Devices." 1969 G-MTT International Microwave Symposium Digest of Technical Papers 69.1 (1969 [MWSYM]): 143-148.

Some properties of high power pulsed GaAs diodes operated in the LSA-mode have been investigated. The present study involves both boat grown, here referred to as "bulk", as well as epitaxial GaAs. The quality of epitaxial GaAs is higher than the quality of bulk GaAs, especially with respect to random doping fluctuations and compensation of carriers. In the case of LSA operation fluctuations in doping density requires light loading of the oscillator in order to prevent formation of high field domains resulting in lower efficiencies. The compensation of bulk GaAs gives rise to a negative temperature coefficient of resistivity which severely limits the operation at high duty cycles or over wide temperature ranges. However, as of yet no epitaxial GaAs is available with thicknesses suitable for very high peak power LSA diodes, bulk material has been partly used in the present investigation to demonstrate the power capabilities and operating conditions of LSA diodes. Some recent results with epitaxial GaAs diodes operated in thick waveguide iris circuits are discussed in the latter part of the paper.

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An All-Transistor, 1-Kilowatt, High-Gain, UHF Power Amplifier

R.L. Bailey, W.P. Bennett, L.F. Heckman and I.E. Martin. "An All-Transistor, 1-Kilowatt, High-Gain, UHF Power Amplifier." 1969 G-MTT International Microwave Symposium Digest of Technical Papers 69.1 (1969 [MWSYM]): 149-153.

An all-transistor power amplifier which delivers a cw power output of 1 kilowatt at 400 MHz has been designed and fabricated. In this design approach, a number of discrete transistors are connrected in parallel to form a power module, and the outputs of a quantity of modules are then combined to achieve the desired total output power. The discrete transistor used in the amplifier is the RCA-2N5016 overlay type. When operated as a single device in an optimum 400-MHz amplifier circuit, this transistor produces a power output of 15 to 18 watts for a power input of 5 to 6 watts.

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Abstracts

A Ten Megawatt Radar Duplexer

J.J. Wormser. "A Ten Megawatt Radar Duplexer." 1969 G-MTT International Microwave Symposium Digest of Technical Papers 69.1 (1969 [MWSYM]): 154-159.

The high power duplexer array illustrated in Figure 1 consists of two balanced hybrid duplexers. Each duplexer is rated at 5 megawatts. The high power transmission is divided equally into two paths. Each path furnishes power to half an orthogonal-feed radar antenna which radiates 10 megawatts in a circular pattern. During high power transmission, the diode driver simultaneously supply forward bias to all T-R diodes. Since the conducting diodes offer a short-circuit across the collinear ports of the high power hybrids, the hybrids are able to route most of the power into the antenna. The leakage signals which escape the T-R short-circuits are terminated harmlessly in the dummy loads which are located on the low power hybrids. Total high power isolation is the sum of the T-R and hybrid isolations. Total high power transmission loss is the sum of the hybrid line and T-R short-circuit losses for each parallel path.

Abstracts

Microwave Energy Applications, Non-Communication (Panel Discussion)

"Microwave Energy Applications, Non-Communication (Panel Discussion)." 1969 G-MTT International Microwave Symposium Digest of Technical Papers 69.1 (1969 [MWSYM]): 160-160.

The panel on Microwave Energy Applications is composed of representatives from five areas of applications of microwave power. Topics to be discussed will be presented from a tutorial point of view, and will include industrial applications, power transmission, solid-state techniques for generation of microwave power, high energy applications (ING proton accelerators, plasma generators, etc.), and biological effects related to microwave energy. Each panel member will give a short formal presentation covering his area of interest, after which the session will be open for general discussion with audience participation.

Abstracts

Techniques for Fabrication and Production of Microwave Integrated Circuits (Panel Discussion)

"Techniques for Fabrication and Production of Microwave Integrated Circuits (Panel Discussion)." 1969 G-MTT International Microwave Symposium Digest of Technical Papers 69.1 (1969 [MWSYM]): 160-160.

The purpose of this panel discussion is to present the most recent technology concerning fabrication and production of microwave components and subsystems using microwave integrated circuits. Each panel member will make a brief formal presentation including (1) a description of the technique(s) used by his company, (2) advantages of the technique(s), i.e. why the company prefers this particular method of fabrication, etc., and (3) report the success to date using examples, stating quantity of circuits in production, etc. After the formal presentations, the panel will be open for general discussion with audience participation.

Abstracts

Noise in Solid State Devices and Systems (Panel Discussion)

"Noise in Solid State Devices and Systems (Panel Discussion)." 1969 G-MTT International Microwave Symposium Digest of Technical Papers 69.1 (1969 [MWSYM]): 161-161.

The principal objective of this panel discussion is to present some of the major problems encountered in dealing with noise in devices and how the device noise affects system performance, Noise in Gunn diode oscillators, avalanche diode oscillators, and multiplier chain sources will be discussed from the component aspect, followed by a discussion of the effects of these noise sources in radar and communication systems. Each panel member will present a formal review of noise in devices or systems as applied to his own area of interest. After the formal presentations, the panel will be open for general discussion with audience participation.

Abstracts

Session TAM-I -- Gunn Effect Devices

"Session TAM-I -- Gunn Effect Devices." 1969 G-MTT International Microwave Symposium Digest of Technical Papers 69.1 (1969 [MWSYM]): 162-162.

Abstracts

The Capabilities and State of the Art of Gunn and LSA Devices

L.F. Eastman. "The Capabilities and State of the Art of Gunn and LSA Devices." 1969 G-MTT International Microwave Symposium Digest of Technical Papers 69.1 (1969 [MWSYM]): 163-169.

Ridley and Watkins conceived of the idea that electrons in solids could be forced to undergo a change in energy and mass that would lead to bulk negative resistance. Hilsum later developed the idea as it applied to Gallium Arsenide with high electric fields applied. Ridley subsequently pointed out the natural tendency of such bulk negative resistance devices to form high-field, traveling domains. Quite independently from the development of these analytical concepts, Gunn experimentally discovered microwave transit-time oscillations in Gallium Arsenide subjected to high electric fields.

Abstracts

Theoretical and Experimental Study of the Quenched-Domain Mode Gunn-Effect Oscillator

D.D. Khandelwal and W.R. Curtice. "Theoretical and Experimental Study of the Quenched-Domain Mode Gunn-Effect Oscillator." 1969 G-MTT International Microwave Symposium Digest of Technical Papers 69.1 (1969 [MWSYM]): 170-175.

A general large-signal analysis of the quenched-domain mode of Gunn-effect devices has been developed which is applicable to any device without extensive device measurements. Some applications of such an analysis are demonstrated and others are being investigated. The phenomenological model includes such effects as domain formation, domain quenching, domain behavior in the presence of an RF voltage, displacement currents, the voltage dependence of domain width and others.

Abstracts

The YIG-Tuned Gunn Oscillator, its Potentials and Problems

M. Omori. "The YIG-Tuned Gunn Oscillator, its Potentials and Problems." 1969 G-MTT International Microwave Symposium Digest of Technical Papers 69.1 (1969 [MWSYM]): 176-181.

The YIG-tuned Gunn oscillator has the capability of achieving broadband tuning with low residual FM noise, as good as or better than that of a reflex Klystron. Our approach to YIG-tuning a Gunn diode is shown in Fig. 1. The uniform precession mode of the YIG sphere acts as a magnetically tunable transmission type resonator. The diode and output loops are orthogonally located so that the coupling is null in the absence of the YIG sphere or magnetic field. The capability of achieving smooth, broadband tuning with medium power output with this approach is illustrated in Fig. 2. The diode was fabricated from Varian-grown, n-type, epitaxial GaAs. The carrier concentration in the solution-grown active layer was 2.5 x 10/sup 15/ cm/sup -3/. The thickness of the epitaxial layer was about 9 m. The Gunn diode was mounted in a 0.76 mm o.d. x 0.3 mm high ceramic package. The YIG sphere had an outside diameter of 1 mm, saturation magnetization of 1780 G, and a line-width of 0.5 Oe. The capability of achieving low noise oscillation, which is comparable to that of a Varian Gunn effect oscillator mounted in a waveguide cavity, is illustrated in Fig. 3. The data was taken from a diode which was oscillating at a frequency of 10.25 GHz with 40 mW of output power. Note that for modulation frequencies greater than 1 KHz from the carrier, the FM noise is as good as or better than that of an ordinary reflex Klystron. This rather good FM noise performance was achieved through circuit optimization and through improvements in the Gunn diode fabrication. The YIG-tuned Gunn oscillator was built for use with a small electromagnet having a gap of 2.8 mm. The entire oscillator, including magnet, weighs 445g and is pictured in Fig. 4.

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The Effect of Temperature on L S A Oscillations Between 26-40 GHz.

S.E. Gibbs. "The Effect of Temperature on L S A Oscillations Between 26-40 GHz.." 1969 G-MTT International Microwave Symposium Digest of Technical Papers 69.1 (1969 [MWSYM]): 182-190.

Investigations have been carried out on the effect of temperature upon L.S.A. oscillations, in the band 26 to 40 GHz. Measurements on n/sup +/-n/sup ++/-n-n/sup +/ GaAs 'sandwich' devices have been made over a range of ambient temperatures -50°C to +100°C. To avoid significant temperature gradients within the active 'n' region the pulse length was chosen to be short compared with the thermal time constant of the device (about 1µs) and the mean input power was maintained at a low level. The results are interpreted with the aid of a computer analysis of the interaction between device and circuit. The simulation considers a realistic device with doping contacts and various random doping fluctuations and attempts to explain some of the essential elements of the experimental performance.

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CW Gunn Diodes in Composite Structure

S. Mitsui and A. Kondo. "CW Gunn Diodes in Composite Structure." 1969 G-MTT International Microwave Symposium Digest of Technical Papers 69.1 (1969 [MWSYM]): 191-195.

It is a way of obtaining a higher output power to operate microwave generators in parallel combinations. It was already reported that several watts of output were obtained with impatt diodes in parallel and series combinations. While, such the attempt at Gunn diodes in CW operation is not seen yet, except for a case of 300 mW output in X-band with a cascaded Gunn oscillator. The present report is related to experimental results of Gunn diodes in composite structure.

Abstracts

X-Band Distributed Array Gunn Effect Transmitter

M.S. Stringfellow, G. Bednar, F.J. Rosenbaum and K.L. Horn. "X-Band Distributed Array Gunn Effect Transmitter." 1969 G-MTT International Microwave Symposium Digest of Technical Papers 69.1 (1969 [MWSYM]): 196-202.

This paper describes the use of injection phase locked Gunn effect oscillators as module transmitters for distributed phased array applications. These devices are capable of direct dc to microwave conversion with reasonable efficiencies and useful power levels. However, certain problem areas must be investigated before they can be successfully employed. These areas include peak and average power output, sensitivity of output power and frequency to the microwave circuit and bias voltage, phase control, reproducibility and cost, driver requirements, and temperature and frequency stability.

Abstracts

Amplitude and Frequency Modulation of CW Gunn Oscillators

W.-C. Tsai and F.J. Rosenbaum. "Amplitude and Frequency Modulation of CW Gunn Oscillators." 1969 G-MTT International Microwave Symposium Digest of Technical Papers 69.1 (1969 [MWSYM]): 203-208.

The use of Gunn oscillators in CW Doppler radar, as local oscillators, and in other system applications often requires automatic frequency and/or phase control, frequency modulation or amplitude modulation. The frequency modulation of CW Gunn oscillators by simultaneously applying ac and dc bias voltages has been described by King and Wasse, who discussed possible modulation mechanisms. Hobson has reported an experimental study of voltage tuning using a biconical cavity. In this paper we present the results of a theoretical and experimental study of AM, FM and AFC of wide-band tunable Gunn oscillators operating in the X-band. The oscillators consist of a Gunn diode mounted on a post in rectangular waveguide. The circuit is loaded with an iris and is tuned over the band with a sliding short located behind the post. The output power as a function of frequency is shown in Fig. 1 for a typical oscillator.

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Session TAM-II -- Millimeter Wave Components

"Session TAM-II -- Millimeter Wave Components." 1969 G-MTT International Microwave Symposium Digest of Technical Papers 69.1 (1969 [MWSYM]): 209-209.

Abstracts

Detection of Millimeter-to-Infrared Radiation

F.R. Arams. "Detection of Millimeter-to-Infrared Radiation." 1969 G-MTT International Microwave Symposium Digest of Technical Papers 69.1 (1969 [MWSYM]): 210-210.

The various mechanisms for the detection of millimeter-to-infrared radiation will be surveyed. Techniques to be covered include intrinsic photoconductors (such as HgCdTe), extrinsic photoconductors (mainly germanium doped with various impurities), free-carrier absorbers (such as InSb), superconducting Josephson-effect point contacts, carbon, and Ge cryogenic bolometers, and room-temperature bolometers (such as the thermistor, thermoelectric, and pyroelectric detectors).

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High Frequency Light Modulators

I.P. Kaminow. "High Frequency Light Modulators." 1969 G-MTT International Microwave Symposium Digest of Technical Papers 69.1 (1969 [MWSYM]): 211-211.

Most applications of lasers require a means for high frequency modulation of the phase, frequency, amplitude or direction of the beam. Light modulators and beam deflectors based on the electro-optic effect in crystals have been operated at X-band (10/sup 10/cps) and there is no reason why they should not work at much higher frequencies. A number of devices have demonstrated the practical feasibility of this technique for some applications while other studies have pointed up the inherent limitations of this and other known modulation methods in important potential applications. The nature of the electro-optic effect, some of the important materials for its application and some of the devices that utilize the effect will be discussed from a tutorial point of view.

Abstracts

Infrared Parametric Amplification Using a Quasi-Microwave Approach to Phase-Matching

D.B. Anderson and J.D. McMullen. "Infrared Parametric Amplification Using a Quasi-Microwave Approach to Phase-Matching." 1969 G-MTT International Microwave Symposium Digest of Technical Papers 69.1 (1969 [MWSYM]): 212-216.

Current nonlinear optical experiments employ birefringence to compensate for the refractive index dispersion to increase the constructive interaction length. Most of the semiconductors have large nonlinear susceptibility coefficients; however, lack the necessary birefringence. Their use has been inhibited by the lack of means to satisfy the phase-match condition for efficient nonlinear interactions. A quasi-microwave approach for the optical region is reported as a means to fulfill the phase-match condition. This approach employs a nonlinear dielectric transmission line with dimenaions comparable to tie wavelength wherein control of the polarization, kind and order of mode is exercised.

Abstracts

Millimeter- and Submillimeter-Wave Detection by Paramagnetic Materials

C.F. Krumm and G.I. Haddad. "Millimeter- and Submillimeter-Wave Detection by Paramagnetic Materials." 1969 G-MTT International Microwave Symposium Digest of Technical Papers 69.1 (1969 [MWSYM]): 217-224.

Due to a lack of powerful signal sources in the millimeter- and submillimeter -wavelength range, a sensitive detector is an essential requirement for work in this frequency band. Adaptations of microwave and optical devices to this wavelength region have many limitations. One means of circumventing the problems associated with operation in this region is to convert the short wavelength radiation to lower frequencies where low noise detection techniques are available. This paper describes the theoretical and experimental evaluation of a downconverter which utilizes paramagnetic materials. Using materials with appropriate zero field splittings this device should be operable over the millimeter-through far-infrared-wavelength range.

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Abstracts

Recent Developments in Millimeter Wave Components

M. Cohn, L.E. Dickens and J.W. Dozier. "Recent Developments in Millimeter Wave Components." 1969 G-MTT International Microwave Symposium Digest of Technical Papers 69.1 (1969 [MWSYM]): 225-231.

Several noteworthy improvements in the state-of-the-art of millimeter wave receiver components have been obtained which are to be reported in this paper. Planar, passivated, GaAs Schottky barrier diodes with very high frequency cut-off characteristics have been developed, and regularly reproduced. These diodes, having f/sub co/ /spl ap/ 1000 GHz at zero bias, have been tailored for use in a line of mixers that covers the 26.5 GHz to 110 GHz range with a typical conversion loss of 5.5 dB at 35 GHz and 8.0 dB at 94 GHz. Mixer noise ratio typically is 1.2 or better for all units. Currently available designs have IF passbands of 100 - 500 MHz, 0.5 - 1.0 GHz, and 1.0 - 2.0 GHZ. The very high f/sub co/ of the diodes has allowed the development of an uncooled degenerate parametric amplifier which has attained a noise figure of 1.7 dB while operating with a gain of 15 dB and an instantaneous signal bandwidth of greater than 800 MHz. The center frequency of the amplifiers is in the 30 - 35 GHz range. The pump power required for full band operation is 10 - 20 mw. The GaAs Schottky barrier diodes have also been designed into several baseband detectors. When biased optimally, an improvement of some 20 - 30 dB in tangential signal sensitivity (TSS) can be obtained in the 70 - 90 GHz range over the TSS available from a biased bolometer and narrow band detector amplifier. Typically the TSS = -51 dBm at 35 GHz and -40 dBm at 94 GHz with a video bandwidth of 10 MHz.

Abstracts

A New Millimeter-Wave Band-Splitting Filter Using Figure-8 Hybrids

S. Shimada, N. Suzuki and I. Ootomo. "A New Millimeter-Wave Band-Splitting Filter Using Figure-8 Hybrids." 1969 G-MTT International Microwave Symposium Digest of Technical Papers 69.1 (1969 [MWSYM]): 232-237.

This paper describes the structure and 3-dB coupling characteristics of a newly developed "figure-8 hybrid" operated in a circular TE/sub 01/ mode, the experimental results for a band-splitting filter using the present hybrids and its application to the branching filter system for the millimeter-wave communication system.

Abstracts

Quasi-Optical Low-Pass Filters which Attenuate by Absorption (1969 [MWSYM])

G.L. Matthaei and D.A. Leedom. "Quasi-Optical Low-Pass Filters which Attenuate by Absorption (1969 [MWSYM])." 1969 G-MTT International Microwave Symposium Digest of Technical Papers 69.1 (1969 [MWSYM]): 238-242.

This paper deals with low-pass filters for quasi-optical microwave, millimeter-wave, or possibly infrared systems where the energy is channeled by focused-beam transmission lines, or by oversized waveguide. Most filters previously studied for applications of these types have been of the kind which attenuate in their stop-bands by reflecting the energy whereas the type of quasi-optical filter to be discussed herein is quite different in that the stop-band attenuation is achieved by absorbing the incident energy. This feature eliminates possible undesirable interaction effects between the filter and the rest of the system. Also, this particular type of filter structure is very attractive in that it has a large stop-band width, and it appears that the stop-band is relatively unaffected by the presence of higher-order modes.

Abstracts

A Perturbation Theory for Dielectric and Optical Waveguides with Application to the Launching of Surface Modes

A.W. Snyder. "A Perturbation Theory for Dielectric and Optical Waveguides with Application to the Launching of Surface Modes." 1969 G-MTT International Microwave Symposium Digest of Technical Papers 69.1 (1969 [MWSYM]): 243-248.

A perturbation technique is employed for dielectric waveguides with a small dielectric difference between the guide and its surrounding medium, resulting in an analytically simple, selfconsistent, theory for surface modes. The field equations are shown to manifest bounded waveguide simplicity. In partitular the transverse electric and magnetic fields are related by a constant and possess the orthogonality of a metal waveguide. Furthermore, an analytic expression is presented for the eigenvalues. Although the analysis is based on small dielectric differences, it is shown to be adequate when the inside dielectric is as large as twice the outside. The results of the perturbation analysis are applied to the excitation of a semi-infinite dielectric rod excited by a uniform field.

Abstracts

Session TPM-I -- Avalanche Diodes

"Session TPM-I -- Avalanche Diodes." 1969 G-MTT International Microwave Symposium Digest of Technical Papers 69.1 (1969 [MWSYM]): 249-249.

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Circuits for High Efficiency Avalanche Diode Oscillators (1969 [MWSYM])

W.J. Evans. "Circuits for High Efficiency Avalanche Diode Oscillators (1969 [MWSYM])." 1969 G-MTT International Microwave Symposium Digest of Technical Papers 69.1 (1969 [MWSYM]): 250-254.

The purpose of this paper is to describe the characteristics of the circuits used to obtain the high efficiency TRAPATT mode of operation in avalanche diodes. A number of interesting facts about the nature of the TRAPATT mode can be inferred from the circuit analysis. The circuit analysis has also been used for the simulation of a complete 500 MHz TRAPATT oscillator on the computer. A computer-generated movie has been made which shows the operation of the simulated TRAPATT oscillator. The simulation of the complete oscillator is very helpful in identifying the physical phenomena which lead to the TRAPATT mode of oscillation. Unfortunately, obtaining the complete solution of all pertinent equations is not practical for many parameter studies. However, a good deal of information about this mode of operation can be obtained by analyzing the circuit and using the results in connection with experimental measurements. The oscillators to be considered here have been realized in coaxial form, similar to the 500 MHz TRAPATT oscillator shown in figure 1. Typically, the oscillator requires some impedance matching element near the diode (although this is not always necessary) and a bandpass filter

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High-Efficiency Avalanche Resonance Pumped Amplification

B. Hoefflinger, C.P. Snapp and L.A. Stark. "High-Efficiency Avalanche Resonance Pumped Amplification." 1969 G-MTT International Microwave Symposium Digest of Technical Papers 69.1 (1969 [MWSYM]): 255-260.

Microwave amplification has been obtained from silicon diodes operated in avalanche resonance pumped modes. DC to RF conversion efficiency was 25% at 1.3 GHz for a saturation gain of 12 dB and a bandwidth of 3%. A nonlinear theory predicts a large dynamic range and efficiencies up to 70%.

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Microstrip High-Power L-Band Avalanche-Diode Oscillator

S.G. Liu. "Microstrip High-Power L-Band Avalanche-Diode Oscillator." 1969 G-MTT International Microwave Symposium Digest of Technical Papers 69.1 (1969 [MWSYM]): 261-265.

A simple microstrip oscillator circuit has been designed for use with the high-power high-efficiency avalanche diodes recently reported. Power outputs of the order of 100 W at L-band with efficiencies between 20 and 30% compare reasonably with that from the coaxial line circuit. This result demonstrates the capability of integration of such high-efficiency diodes for system applications. The diode chips used for the microstrip circuit are punch-through PNN/sup +/ silicon mesa diodes with junctions formed by diffusion of boron into N-type silicon epitaxial wafers. The resistivity of the epitaxial layer is 5 to 7 ohm-cms, and the width of the N-region is about 6 µm. Mesa diameters range from 0.018 in. to 0.023 in., and the breakdown voltages of the diodes are between 120 and 160 volts.

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A One Watt CW Avalanche Diode Source or Power Amplifier

J.J. Sie and W.J. Crowe. "A One Watt CW Avalanche Diode Source or Power Amplifier." 1969 G-MTT International Microwave Symposium Digest of Technical Papers 69.1 (1969 [MWSYM]): 266-272.

Methods of extending the dynamic range of solid state negative resistance amplifiers have been suggested which employ a "traveling wave" approach, and a cascading approach. This has also been applied to oscillators. There are reports of frequency locking of several coupled oscillators to combine their individual output powers. This paper describes the generation of 1 Watt CW at X-band by a specific method of cascading one avalanche diode oscillator and three avalanche diode power amplifiers. The diodes used are the diffused gallium arsenide units recently constructed in an inverted structure in the Micro State device laboratory, capable of generating over 300 mW CW at X-band.

Abstracts

Computer-Aided Small-Signal Characterization of IMPATT Diodes (1969 [MWSYM])

C.N. Dunn and J.E. Dalley. "Computer-Aided Small-Signal Characterization of IMPATT Diodes (1969 [MWSYM])." 1969 G-MTT International Microwave Symposium Digest of Technical Papers 69.1 (1969 [MWSYM]): 273-277.

The use of a general purpose digital computer to convert microwave impedance measurement data to useful forms and simultaneously correct for system errors was described in an earlier paper. The method is applied to the small-signal characterization of germanium IMPATT diodes in the frequency range of 2.0 to 8.0 GHz in this paper. Since the equivalent circuit of the IMPATT diode is at least as complicated as equivalent circuits for other types of microwave diodes, the techniques demonstrated can easily be applied to other types of diodes.

Abstracts

X-Band Solid-State Oscillator and Mixer

W.B. Day and W.M. Jones. "X-Band Solid-State Oscillator and Mixer." 1969 G-MTT International Microwave Symposium Digest of Technical Papers 69.1 (1969 [MWSYM]): 278-280.

An oscillator/mixer assembly has been developed which employs an avalanche transit-time oscillator (ATTO) as the local oscillator for a wide band mixer. The oscillator is electrically tunable from 7.5 to 11.5 GHz, with a yttrium-iron-garnet toroid as the principal tuning element, and the overall single side-band noise figure of the assembly varies from 9 db (at center of band) to 11 db at the band edges. When used with a klystron local oscillator the mixer displays a noise figure of less than 9 db over this frequency range.

Abstracts

Broadband Negative Resistance Oscillator Circuits

K. Kurokawa, J.P. Beccone and N.D. Kenyon. "Broadband Negative Resistance Oscillator Circuits." 1969 G-MTT International Microwave Symposium Digest of Technical Papers 69.1 (1969 [MWSYM]): 281-284.

Negative resistance oscillators can perform various functions other than just fixed frequency oscillations. For example, the electronic tuning effect is commonly used to generate FM signals and the injection locking phenomenon can be utilized for FM amplification, limiting and demodulation. For fixed frequency oscillations, the oscillator resonant circuit is generally designed to have as high an external Q as possible for good frequency stability and noise performance. However, for the other applications mentioned above, relatively broadband circuits are desired. This paper discusses various factors to be considered in their design.

Abstracts

Session TPM-II -- Passive Components

"Session TPM-II -- Passive Components." 1969 G-MTT International Microwave Symposium Digest of Technical Papers 69.1 (1969 [MWSYM]): 285-285.

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Synthesis of High-Power Harmonic Rejection Waveguide Filters

R. Levy. "Synthesis of High-Power Harmonic Rejection Waveguide Filters." 1969 G-MTT International Microwave Symposium Digest of Technical Papers 69.1 (1969 [MWSYM]): 286-290.

Waveguide filters for rejection of harmonic power content of high-power transmitters are widely used, and corrugated waveguide or waffle-iron filters are most commonly employed for this application. The method of design described in the literature is based on the use of image parameters, and may be considered a rather complicated non-optimum procedure which may be difficult to control, particularly in regard to pass band VSWR, since empirical adjustments are usually required. The new methods described here are based on synthesis techniques, and give practical results close to the initial specifications. Only filters of the reflective type will be discussed, but occasionally conversion to the absorptive class is feasible.

Abstracts

Predistorted Waveguide Filters for Use in Communications Systems

R.M. Livingston. "Predistorted Waveguide Filters for Use in Communications Systems." 1969 G-MTT International Microwave Symposium Digest of Technical Papers 69.1 (1969 [MWSYM]): 291-297.

Predistortion is a standard technique for correcting the effects of energy dissipation in filters, making their response conform to that of ideal filters. The problem of dissipation is particularly noticeable in narrowband bandpass filters used in microwave communications systems. Dissipation makes the passband edges slump downward, as shown in Figure 1, which can cause distortion and intermodulation. In predistorting a filter, we allow for dissipation in the initial design. A response approximating the ideal response can be approximated at the price of increased insertion loss. The flat response of predistorted filters is advantageous when used in high-capacity microwave communications systems; however, the filters have an additional property which makes them especially attractive for certain applications in microwave communications systems.

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Narrow Bandwidth Elliptic-Function Filters (1969 [MWSYM])

I. Rubinstein, R.L. Sleven and A.F. Hinte. "Narrow Bandwidth Elliptic-Function Filters (1969 [MWSYM])." 1969 G-MTT International Microwave Symposium Digest of Technical Papers 69.1 (1969 [MWSYM]): 298-303.

Although wide bandwidth microwave elliptic-function filters have previously been reported, this paper describes a circuit which provides, for the first time, a narrow bandwidth elliptic-function response at microwave frequencies. It is for narrow bandwidth applications (from 5 percent to a fraction of a percent) that the elliptic-function filter offers its most important advantages over other filter types--lower loss and greater selectivity. These features are verified by theoretical analysis and experimental data on a 1-percent bandwidth S-band stripline filter. The design of the filter, which is based upon the low-pass prototype, is simple to obtain with the relationships presented in this paper, and the elliptic-function response is readily realizable in printed or other TEM transmission lines. A waveguide elliptic-function filter is also discussed, but experimental verification of this has not yet been attempted.

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The Stepped Cavity Coupled Elliptic Filter

J.D. Rhodes. "The Stepped Cavity Coupled Elliptic Filter." 1969 G-MTT International Microwave Symposium Digest of Technical Papers 69.1 (1969 [MWSYM]): 304-309.

A design procedure is presented whereby compact, narrow-band (<30%) T.E.M. line, band-pass, elliptic function filters may be realized. The proposed realization is in the form of a stepped impedance, digital n-wire line which is one half of a wavelength long at midband and short circuited to ground at both ends, where the digital line is stepped in impedance along any arbitrary prescribed plane in the filter. Due to its physical form and the mode of electrical operation, the filter has been called "The Stepped Cavity Coupled Elliptic Filter". Recently, "The Stepped Digital Elliptic Filter" has been proposed as a realization of the narrow-band, band-pass elliptic filter and consisted of a stepped impedance digital n-wire line, one quarter of a wavelength long at mid-band where the line was shorted to ground at one end and open-circuited at the opposite end. In this filter, the fringing capacitances at the open-circuited ends of the line necessitate the use of a compensation procedure based upon an estimation of these parasitic lumped capacitances. Consequently, in the very narrow-band cases, where these end effect capacitances have a considerable effect upon the performance of the filter, it is very difficult to construct a filter with the required electrical performance. In the new design procedure, this problem is eliminated since the digital line is short circuited to ground at both ends and this also provides the filter with greater physical rigidity.

Abstracts

Design of Commensurate Transmission Line Circuits (1969 [MWSYM])

W. Steenaart and R.J. Murphy. "Design of Commensurate Transmission Line Circuits (1969 [MWSYM])." 1969 G-MTT International Microwave Symposium Digest of Technical Papers 69.1 (1969 [MWSYM]): 310-316.

Digital computer techniques are developed for the approximation of the periodic frequency characteristics of commensurate transmission line circuits. For a given periodic delay or loss-derivative function the system function is derived automatically using a direct method. Any suitable synthesis program will complete the design.

Abstracts

Some Magic Tees with 2 to 3 Octaves Bandwidth

A.F. Podell. "Some Magic Tees with 2 to 3 Octaves Bandwidth." 1969 G-MTT International Microwave Symposium Digest of Technical Papers 69.1 (1969 [MWSYM]): 317-319.

Techniques have been developed which extend the frequency range of ring magic tees to 7:1 or more. Experimental 250 to 1000 MHz ring magic tees have been built with 0.6 db insertion loss (above the 3 db power split), 0.2 db amplitude balance, 2° phase balance, and a 1.5:1 maximum VSWR over the 2-octave frequency range. An experimental 300 to 1800 MHz ring magic tee has been built with the performance shown in Figure 5. Figure 1 shows schematically the basic ring magic tee, and a typical curve of VSWR versus electrical length. The four transmission lines are nominally 70.7 ohms characteristic impedance for a maximally flat design. If the line impedances are made 65 ohms, then the basic design has an equal ripple 1.18:1 VSWR bandwidth of one octave.

Abstracts

An Asymmetric Non-Monotonic Stripline Magic-T

E.W. Carpenter. "An Asymmetric Non-Monotonic Stripline Magic-T." 1969 G-MTT International Microwave Symposium Digest of Technical Papers 69.1 (1969 [MWSYM]): 320-323.

Several techniques have been described in the literature for the design of Magic-T circuits in a strip-transmission-line configuration. Among these are the symmetrical quadrature coupler used in conjunction with the 90° Schiffman phase shifter, the tapered (or stepped) line coupler designed using an impedance transformer prototype, and the asymmetric coupler with a Schiffman phase compensator. This paper describes a new cascaded coupled TEM transmission line Magic-T which requires less overall path length to achieve a specified performance than any of these earlier designs. The design employed in this report was suggested by the unusual configuration employed by R. Pegis. The coupler equivalent for an optical filter design of this broadband -3 db optical filter has the performance of a Magic-T over a portion of the coupler bandwidth. This coupler has a number of coupled sections which have monotonically increasing even mode impedance and an equal number of non-monotonic weakly coupled sections. The resulting 8-section coupler gives a -3.01± .22 db coupling over a 17:1 bandwidth. This is slightly better than the balance which can be achieved with an asymmetric coupler of 8 sections. The existence of such an asymmetric non-monotonic Magic-T was also suggested by Young.

Abstracts

The Even and Odd Mode Capacitance Parameters for Coupled Lines in Suspended Substrate (1969 [MWSYM])

J.I. Smith. "The Even and Odd Mode Capacitance Parameters for Coupled Lines in Suspended Substrate (1969 [MWSYM])." 1969 G-MTT International Microwave Symposium Digest of Technical Papers 69.1 (1969 [MWSYM]): 324-328.

This paper describes the calculation of fringing capacitances in the suspended substrate transmission medium. In this medium, conductors are photoetched on one side of a dielectric card supported approximately halfway between two parallel ground planes. Usually a large number of thin film circuits are supported on a single card and are therefore coupled. The parameters needed to characterize coupled microwave structures are the surge impedances and phase velocities of the normal modes. For lumped circuits, or combinations of lumped circuits and distributed structures, which are quite common, the parasitic capacitances between adjacent conductors and the capacitances to ground are required. All these parameters can be found from the odd and even mode static capacitances for two parallel coupled lines. The transmission medium is inhomogeneous (the dielectric medium that supports the conductors is suspended in air as seen in Figure 1) so that not only are the system capacitances required with dielectrics present, but also required are these capacitances with all dielectrics removed. From this last, homogeneous, case the line inductance in an assumed TEM mode is found. The methods of calculation outlined here of the even and odd mode capacitances for both homogeneous and inhomogeneous cases are based on a variational approximation and on several conformal transformations. Their use at an interactive time share terminal has proven very valuable in the design of low loss, high performance microwave circuits.

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Coupled Transmission Line Networks in an Inhomogeneous Dielectric Medium (1969 [MWSYM])

A.K. Johnson and G.I. Zysman. "Coupled Transmission Line Networks in an Inhomogeneous Dielectric Medium (1969 [MWSYM])." 1969 G-MTT International Microwave Symposium Digest of Technical Papers 69.1 (1969 [MWSYM]): 329-337.

In this paper, two-port networks composed of two identical, coupled transmission lines embedded in an inhomogeneous dielectric (e.g., suspended substrate, microstrip) are investigated. The ABCD parameters of circuit configurations, considered by Jones and Bolljahn, are obtained for the case of inhomogeneous dielectric. Equivalent circuits of these networks are also given. It is shown that the characteristics of such circuits differ markedly from those embedded in a homogeneous medium. In addition experimental results are presented for three types of circuits which have been constructed and tested. There is excellent agreement between the experimental results and those predicted theoretically on the basis of the equivalent circuits.

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Session WAM-I -- Microwave Acoustics

"Session WAM-I -- Microwave Acoustics." 1969 G-MTT International Microwave Symposium Digest of Technical Papers 69.1 (1969 [MWSYM]): 338-338.

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Acoustic Wave Analysis, Using Microwave Concepts

B.A. Auld. "Acoustic Wave Analysis, Using Microwave Concepts." 1969 G-MTT International Microwave Symposium Digest of Technical Papers 69.1 (1969 [MWSYM]): 339-346.

The purpose of this paper is to point out the potential usefulness in microwave acoustics of the large body of analytical concepts and techniques which have been developed in microwave electromagnetic theory. These methods are readily transferable because the acoustic and electromagnetic equations are basically analogous. This is brought out clearly by expressing the acoustic equations in the vector notation normally used in electromagnetism.

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A Review of the State-of-the-Art of Surface Acoustic Wave Technology

E. Stern. "A Review of the State-of-the-Art of Surface Acoustic Wave Technology." 1969 G-MTT International Microwave Symposium Digest of Technical Papers 69.1 (1969 [MWSYM]): 347-353.

Until recently, acoustic devices have been of the bulk form. The typical bulk, wave device consists of a crystalline block to which opposing piezoelectric transducers are attached. The piezoelectric transducer emits a narrow beam of acoustic energy into the material. Some of the energy is intercepted at the output transducer and reconverted to an electrical signal. The acoustic signal is virtually inaccessible during transit. If the acoustic energy is moved to the surface of the crystal, a considerable amount of manipulation becomes feasible, including wave guidance, switching, amplification, tapping, and power splitting functions. This, in essence, is the microsound principle, the exploitation of which is the subject of this paper. The manipulation of the acoustic energy is accomplished with the aid of three fundamental components: the transducer, the amplifier, and the waveguide.

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Acoustic Surface-Waves and Rayleigh-Type Spin-Waves at Microwave Frequencies

P.H. Carr, A.J. Slobodnik, Jr. and J.C. Sethares. "Acoustic Surface-Waves and Rayleigh-Type Spin-Waves at Microwave Frequencies." 1969 G-MTT International Microwave Symposium Digest of Technical Papers 69.1 (1969 [MWSYM]): 354-358.

The recent observation of acoustic surface waves up to 3 GHz offers the promise of microwave-acoustic integrated-circuits and components, which would be five orders of magnitude smaller than their electromagnetic equivalents. The practicality of such "microsound" circuits will depend to a considerable degree on the magnitude of the transducer insertion loss and on the acoustic propagation loss. The first part of this paper will deal with these losses on optically polished dielectric single crystal substrates. It should be noted that the acoustic losses in polycrystalline materials are prohibitively high at microwave frequencies. The second part will deal with the propagation of Rayleigh-type spin-waves on magnetic substrates. These surface spin-waves are nonreciprocal in their propagation characteristics and therefore offer the possibility of surface wave isolators.

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Room Temperature Electron Paramagnetic Resonance (EPR) Signal Storage

D.A. Bozanic, D.C. Buck, F.H. Harris, R.E. Huber, D. Mergerian and R.W. Minarik. "Room Temperature Electron Paramagnetic Resonance (EPR) Signal Storage." 1969 G-MTT International Microwave Symposium Digest of Technical Papers 69.1 (1969 [MWSYM]): 359-365.

The concept of a spin echo was first introduced and subsequently observed in a system of nuclear spins by E. L. Hahn in 1950. Later experiments performed by R. J. Blume in 1958 first demonstrated the phenomenon in electron spin systems. These echo experiments have since been the subject of a considerable amount of research performed by Mims, et. al. Recently, Bozanic, et. al. extended the temperature range at which spin echo experiments were performed from liquid helium to ambient temperatures by observing spin echoes in irradiated fused silica. On the basis of these room temperature experiments it is now feasible to utilize the spin echo phenomenon in microwave signal storage devices with time delays in excess of 150 µsec attained at room temperature for X-band signals. Other schemes to produce delays such as using superconducting lines, electron beams, acoustic and magnetic waves are impractical for delays greater than 10 µsec in the spectrum above C-Band.

Abstracts

Active Impedance Matching for Microwave Acoustic Delay Lines

R.Y.C. Ho and A.J. Bahr. "Active Impedance Matching for Microwave Acoustic Delay Lines." 1969 G-MTT International Microwave Symposium Digest of Technical Papers 69.1 (1969 [MWSYM]): 366-370.

Recently, it has been shown that an inverted common-collector transistor circuit can be used to synthesize a high-Q inductance that is useful at microwave frequencies for realizing filters, matching networks, multiplexer, and other normally passive components. The basic transistor circuit is shown in Fig. 1(a). The principle of operation may be explained with the aid of Fig. 1(b), which shows the focus of the quantity (1 - alpha) in the complex plane as a function of frequency. (alpha is the short-circuit current gain of the transistor and omega/sub alpha/ is the alpha-cutoff frequency.) It is seen that the circuit is basically an impedance rotator. If Z is a resistor (in the base), a virtual inductance is seen at the emitter; if Z is an inductance, a virtual negative resistance appears at the emitter. Typical experimental plots of the real and imaginary parts of Z', the impedance seen at the emitter, as functions of frequency are shown in Fig. 2. The ability to synthesize both an inductance and a negative resistance places this circuit in a unique position with regard to its use in the realization of impedance-matching networks for microwave acoustic delay lines. This is because the negative resistance can be used to compensate exactly for the positive resistances that represent electrical dissipation losses in the transducer and matching network. The significance of this technique will be made clear in what follows.

Abstracts

Laser-Acoustic Microwave Signal Processing

H.A. Heynau and M.J. Brienza. "Laser-Acoustic Microwave Signal Processing." 1969 G-MTT International Microwave Symposium Digest of Technical Papers 69.1 (1969 [MWSYM]): 371-375.

The variable delay and processing of RF and microwave signals is a current problem of considerable importance both for the many military applications in radar and electronic countermeasures and for the civilian applications in signal processing. The very low velocity of acoustic waves, as compared to the propagation velocity of electromagnetic signals, permits the fabrication of physically compact systems capable of storing and processing electromagnetic signals. For example, a 1 µsec delay in a non-acoustic delay line might require 700 feet of coaxial cable as compared to the ½ cm of material required in an acoustic delay line. While acoustic delay lines have fulfilled many of the needs of fixed delay lines, adequate continuously variable delay lines are not presently available. Among the several suggestions for obtaining a continuously variable delay, the use of the laser-acoustic interaction has been shown to be among the most promising. This paper will discuss the principles of such a laser-acoustic delay line and the extension of this device to a microwave signal processing device for performing either time compression, expansion and reversal or pulse compression, expansion and reversal.

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Propagating Magnetic Waves in Epitaxial YIG

W.L. Bongianni, J.H. Collins, F.A. Pizzarello and D.A. Wilson. "Propagating Magnetic Waves in Epitaxial YIG." 1969 G-MTT International Microwave Symposium Digest of Technical Papers 69.1 (1969 [MWSYM]): 376-380.

The theoretical work of Damon and Eshbach leads to the prediction of magnetostatic surface and volume wave propagation in ferromagnetic slabs. Experimental work of Brundle and Freedman with slabs of flux-grown YIG have demonstrated the existence of both these wave classes. In this paper we report the use of YIG films grown by the method of chemical vapor deposition (CVD) on gadolinium gallium garnet to generate such waves. CVD allows films with thickness orders of magnitude smaller than those fabricated from flux-grown material to be obtained. The advantage of such thin films is the uniformity of internal dc field that can be obtained. Figure 1 is a plot of the demagnetizing field in a 1 cm x 0.5 cm YIG slab of varying thickness as calculated from the analysis of Joseph and Schlomann. The external dc field is along the z-axis. The demagnetization variation is shown along this direction from the face to the center of the slab. For a 10 micron thick film, approximately 60 percent of the distance along the z-axis varies by less than 1.0 oe and 95 percent by less than 10 oe. This is about two orders of magnitude less than a slab of 1 mm thickness, which is a typical thickness used by previous investigators. Measurements were made on epitaxial YIG films ranging in thickness from 4 microns to 50 microns. The ferromagnetic resonance linewidth of these epitaxial films has been measured and found to be typically 1.5 oe at X-band, when the bias field is applied perpendicular to the film plane.

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Session WAM-II -- Computer-Oriented Microwave Techniques

"Session WAM-II -- Computer-Oriented Microwave Techniques." 1969 G-MTT International Microwave Symposium Digest of Technical Papers 69.1 (1969 [MWSYM]): 381-381.

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Optimization of Microwave Networks by Razor Search (1969 [MWSYM])

J.W. Bandler and P.A. Macdonald. "Optimization of Microwave Networks by Razor Search (1969 [MWSYM])." 1969 G-MTT International Microwave Symposium Digest of Technical Papers 69.1 (1969 [MWSYM]): 382-387.

A new automatic optimization method called Razor Search is presented. The method, which is based on pattern search, was specifically developed for the optimization by computer of networks for which the objective is to minimize the maximum deviation of some response from a desired ideal response specification. Examples falling within the scope of this paper are shown in Fig. 1.

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Dominant Pole Synthesis of Transmission Line Networks (1969 [MWSYM])

S. Mahdi and A.B. Macnee. "Dominant Pole Synthesis of Transmission Line Networks (1969 [MWSYM])." 1969 G-MTT International Microwave Symposium Digest of Technical Papers 69.1 (1969 [MWSYM]): 388-391.

This paper describes a procedure for synthesizing transmission networks which are interconnections of uniform line elements. An iterative, digital computer algorithm is developed which achieves a dominant pole synthesis. The line lengths and the characteristic impedances are controlled individually, which gives design flexibility not found in synthesis procedures based on Richard's transformation. Thus, the characteristic impedances may be restricted by upper and lower bounds when there is no restriction on the line lengths. The procedure is detailed for a TEM mode structure of alternating open stubs and connecting lines. The method uses a Newton-Raphson iterative scheme to adjust the characteristic impedances and lengths of the transmission lines for a prescribed set of dominant transmission poles. If the poles are chosen to give a low-pass characteristic when all of the transmission zeros are at infinity, the finite transmission zeros produced by the stubs modify substantially the transfer characteristic realised. By controlling the stub line lengths and modifying the dominant pole positions an improved transmission characteristic and bounded characteristic impedances can be achieved simultaneously.

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Computer Aided Design of Broadband and Low-Noise Microwave Amplifiers

T.W. Houston and L.W. Read. "Computer Aided Design of Broadband and Low-Noise Microwave Amplifiers." 1969 G-MTT International Microwave Symposium Digest of Technical Papers 69.1 (1969 [MWSYM]): 392-396.

The design of low-noise broadband microwave integrated amplifiers is particularly suited to the application of optimization techniques. Circuit theory is incapable of synthesizing these circuits, and bread-boarding is expensive as well as difficult. The analytical solution of microwave integrated circuits has been developed, and though complicated, is suitable for computer solution. It is then possible for the engineer to use a computer model of a circuit as a breadboard; however, with the many variables and the conflicting objectives of high flat broadband gain and low-noise figure it is best to leave the tuning of this breadboard to an optimization routine. This paper presents an objective function for the optimization of low noise broadband amplifiers. The effectiveness of this technique is demonstrated with examples.

Abstracts

Computer-Aided Design of 3-Port Waveguide Junction Circulators

J.B. Castillo and L.E. Davis. "Computer-Aided Design of 3-Port Waveguide Junction Circulators." 1969 G-MTT International Microwave Symposium Digest of Technical Papers 69.1 (1969 [MWSYM]): 397-401.

The purpose of this work is to determine the usefulness of numerical-analysis in the design of 3-port waveguide circulators. Present design techniques permit the selection of an optimum ferrite for a particular frequency range, but very little detailed prediction of performance as is usual in filter design, for example, has been attempted. This is due to the complexity of the problem and the fact that almost all of the successful empirically designed configurations are not amenable to theoretical analysis. Our efforts have been directed towards those structures which can in principle be analysed rigorously, but which do not necessarily have good performance rather than those which have good performance but can be modeled only approximately. In this paper we are interested in the feasibility of a detailed waveguide circulator theory, and we wish to clarify the effects of some important parameters. The result of this work has been computer-generated, simulated swept-frequency predictions of circulator performance which can be directly compared with laboratory measurements.

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New Directions in Computer Field Analysis

A. Wexler. "New Directions in Computer Field Analysis." 1969 G-MTT International Microwave Symposium Digest of Technical Papers 69.1 (1969 [MWSYM]): 402-402.

Whenever one devises a mathematical expression to solve a field quantity, one must be concerned with numerical analysis. Other than those engineers involved exclusively in measurements or in the proof of general existence theorems or in administration, the remainder of us are numerical analysts to a degree. Whenever we prescribe a sequence of mathematical operations, we are designing an algorithm. A theory is to us a means of extrapolating our experiences in order to make predictions. A mathematical theory, of a physical problem, produces numbers and a good theory produces accurate numbers easily.

Abstracts

A Comparison of Two Numerical Computer Methods for Solving TEM Field Problems

E.G. Cristal. "A Comparison of Two Numerical Computer Methods for Solving TEM Field Problems." 1969 G-MTT International Microwave Symposium Digest of Technical Papers 69.1 (1969 [MWSYM]): 403-405.

The use of the computer as a primary tool in semi- or fully-automatic network design is currently of considerable interest. Perhaps of less interest, but nonetheless quite important, is the use of computers as a primary tool in solving complex electromagnetic field problems in order to obtain useful microwave design data. In the latter case, for two-dimensional TEM problems, the integral and difference equation methods are those most often programmed on a computer to obtain the needed data. An engineer wishing to use one of these methods to solve some complex field problem is faced, at the onset, with important, practical questions: Which method requires less analytical preparation? Which method requires less preparation for programming, and takes less time to program? Which method will cost less oveall in obtaining the data to the required accuracy? What are some of the particularly bad problem spots for which a given method may fail to give accurate results?

Click on title for a complete paper.

Abstracts

Intermodal Coupling at the Junction Between a Straight and a Continuously Curved Waveguide of Rectangular Cross Section

C.P. Bates. "Intermodal Coupling at the Junction Between a Straight and a Continuously Curved Waveguide of Rectangular Cross Section." 1969 G-MTT International Microwave Symposium Digest of Technical Papers 69.1 (1969 [MWSYM]): 406-410.

In a microwave system for guiding electromagnetic waves one often encounters waveguide bends formed by the interconnection of straight and continuously curved waveguides of rectangular cross section. Precise numerical computations and extensive analytical investigations of the angular propagation constants for the various electromagnetic modes which may exist in the curved section alone have been investigated by many researchers, in particular by Cochran and Pecina (1966). In contradistinction to the above, the propagation constants and modal fields which may exist in the straight sections alone are trivial. An understanding of the propagation of electromagnetic waves through these waveguide bends requires, therefore, a complete comprehension of the intermodal coupling that takes place at the various junctions and discontinuities. This talk will discuss in detail the coupling that occurs at a junction between a straight and a continuously curved waveguide of rectangular cross section.

Abstracts

Computer Aided Solution of Vector Field Boundary Value Problems in Three Dimensions

G.K. Cambrell. "Computer Aided Solution of Vector Field Boundary Value Problems in Three Dimensions." 1969 G-MTT International Microwave Symposium Digest of Technical Papers 69.1 (1969 [MWSYM]): 411-417.

The analysis of many microwave devices, for example, an electromagnetic cavity containing inhomogeneous anisotropic medium, involves the solution of a vector field, boundary value problem in three dimensions. The method of moments (in particular, that of Galerkin or Rayleigh-Ritz) is a well known general technique of field computation. For a region of arbitrary shape, a basic difficulty of the method of moments is the generation of a set of expansion functions that are complete over the region and which converge not only inside the region but also on the boundary. This paper outlines a systematic technique for generating such a set with the aid of a computer.

Abstracts

Session WPM-I -- Microwave Integrated Circuits II

"Session WPM-I -- Microwave Integrated Circuits II." 1969 G-MTT International Microwave Symposium Digest of Technical Papers 69.1 (1969 [MWSYM]): 418-418.

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Abstracts

Integrated S-Band Parametric Amplifier

R.S. Forman. "Integrated S-Band Parametric Amplifier." 1969 G-MTT International Microwave Symposium Digest of Technical Papers 69.1 (1969 [MWSYM]): 419-425-B.

Parametric amplifiers have been used for many years in low noise receiver applications. Within the past few years, the development of direct solid state pump sources, such as avalanche diode and Gunn-effect oscillators, has widened the utility of paramps to include systems for which klystron pumped devices are unsuitable. These solid state pumped paramps provide low noise amplification in reasonably compact packages with low power consumption and excellent long term stability.

Abstracts

Integrated Parametric Amplifiers with IMPATT-Diode Pumping

P. Bura, W.Y. Pan and S. Yuan. "Integrated Parametric Amplifiers with IMPATT-Diode Pumping." 1969 G-MTT International Microwave Symposium Digest of Technical Papers 69.1 (1969 [MWSYM]): 426-431.

Hybrid integrated parametric amplifiers (paramps) have been developed for different S-Band frequencies. The amplifier circuits were etched on a 1 in. x 1 in. copper-on-alumina substrate. Voltage gain-bandwidth products of 800 MHz and noise figures as low as 1.2 dB were measured. An IMPATT-Diode oscillator was used as the pump source. The paramp noise problem due to the IMPATT oscillator was determined and remedied.

Abstracts

A 1.8 to 4.2 GHz YIG Tuned Transistor Oscillator with a Wideband Buffer Amplifier

J.J. Dupre. "A 1.8 to 4.2 GHz YIG Tuned Transistor Oscillator with a Wideband Buffer Amplifier." 1969 G-MTT International Microwave Symposium Digest of Technical Papers 69.1 (1969 [MWSYM]): 432-438.

The recent availability of accurately characterized transistors with maximum frequencies of oscillation in excess of 7 GHz has made possible the development of electrically tunable oscillators and wideband amplifiers with greater than octave coverage in the microwave region. Utilizing these devices on thin film microcircuits allows for more complex designs and the combining of functions on a single substrate. The component to be described combines a YIG tuned oscillator and a wideband amplifier on a .500 by .375 inch sapphire substrate.

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A Hybrid Integrated Transistor Amplifier for High-Volume Production

M.M. Hower and K.F. Sodomsky. "A Hybrid Integrated Transistor Amplifier for High-Volume Production." 1969 G-MTT International Microwave Symposium Digest of Technical Papers 69.1 (1969 [MWSYM]): 439-444.

Recent advances in microwave circuit technology and characterization capability have led to new approaches to microwave circuit design and manufacture. As an example in the use of such new methods, this paper will describe the design of an L-band transistor amplifier intended for phased array applications. The circuit and device designs and assembly procedures developed were specifically oriented for large-scale manufacture with a consequent emphasis on the use of computers for data processing and component selection.

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200 Watt Solid State UHF Amplifier

D. Staiman and M. Breese. "200 Watt Solid State UHF Amplifier." 1969 G-MTT International Microwave Symposium Digest of Technical Papers 69.1 (1969 [MWSYM]): 445-449.

A high power transistor amplifier with an output of 200 W peak at a center frequency of 432 MHz is described. Eight TRW 2N5177 transistors are operated in parallel by means of a network of split-tee hybrid junctions as shown in Figure 1. The individual amplifier circuits, as well as the hybrid junction network, are etched microstrip circuits on high purity alumina substrates.

Abstracts

A Hybrid Integrated Circuit Microwave Telemetry Transmitter and Command Receiver

J.C. Pinac and B.S. Skinner, Jr.. "A Hybrid Integrated Circuit Microwave Telemetry Transmitter and Command Receiver." 1969 G-MTT International Microwave Symposium Digest of Technical Papers 69.1 (1969 [MWSYM]): 450-457.

A study of solid-state integrated microwave circuits, techniques, and components was conducted by Texas Instruments Incorporated. The purpose of this study was to define, both analytically and experimentally, the problem areas associated with integrated circuits when various combinations of active and passive circuit elements are required to perform a complete circuit function at microwave frequencies. In order that future operational requirements would be met, specific design goals were established. These design goals were an FM telemetry transmitter and a command receiver. The study program consisted of four general categories of effort: Analytical study of techniques and components, System definition and parameter analysis, Circuit design, Fabrication and test.

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Session WPM-II -- Millimeter Wave Systems

"Session WPM-II -- Millimeter Wave Systems." 1969 G-MTT International Microwave Symposium Digest of Technical Papers 69.1 (1969 [MWSYM]): 458-458.

Abstracts

Comparison of Theoretical and Experimental Values of Phase Constant for Dipole Mode Surface Wave Propagation in Open Gyromagnetic Ferrite Rod

F.R. Seyfried and J.S. Lee. "Comparison of Theoretical and Experimental Values of Phase Constant for Dipole Mode Surface Wave Propagation in Open Gyromagnetic Ferrite Rod." 1969 G-MTT International Microwave Symposium Digest of Technical Papers 69.1 (1969 [MWSYM]): 459-466.

The formulation of Maxwell's equations as an eigenvalue problem in operator notation enables application of operator methods, Schroedinger scalar perturbation theory, and mode orthogonality conditions to the solution of propagation problems in uniform waveguides. Gabriel and Brodwin initiated this approach for obtaining approximate solutions for waveguiding problems involving inhomogeneous, anisotropic, dissipative media in conventional waveguide in which the presence of the media was considered a perturbation of the conditions present in the empty waveguide. Lee extended this theory to open gyrotropic dielectric waveguide by considering the gyrotropy of the rod to be a perturbation of the conditions present in an open isotropic dielectric waveguide. In particular, Lee obtained a perturbation solution for waveguiding of the HE/sub 11/ (dipole) surface wave mode in a longitudinally magnetized open gyromagnetic ferrite rod by considering the anisotropy of the ferrite induced with the application of the small dc magnetic field.

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Optical Display of Millimeter-Wavelength Radiometric Maps with Good Spatial, Temporal, and Temperature Resolutions

F.I. Shimabukuro. "Optical Display of Millimeter-Wavelength Radiometric Maps with Good Spatial, Temporal, and Temperature Resolutions." 1969 G-MTT International Microwave Symposium Digest of Technical Papers 69.1 (1969 [MWSYM]): 467-469.

The ideal instrument for radio mapping would make high resolution maps in a short time with good temperature discrimination. Good temperature resolution, except at those wavelengths where the atmosphere is highly absorptive and/ or the state -of-the-art instrumentation has not developed sensitive radiometers, is usually not a limitation. In radio mapping, good spatial and temporal resolutions are conflicting and, generally, radio systems that have good spatial resolution have poor time resolution, and vice versa. This generalization is not true for some of the electronically scanning antenna systems operating at the longer wavelengths.

Abstracts

Near Earth Millimeter Wave Radar and Radiometry

K.A. Richer. "Near Earth Millimeter Wave Radar and Radiometry." 1969 G-MTT International Microwave Symposium Digest of Technical Papers 69.1 (1969 [MWSYM]): 470-474.

The Army is interested in detection systems operating on the earth or at relatively low altitudes. Hopefully, these systems will detect targets, identify them, and guide missiles to the targets. Since grazing angles of 0.1 to 1 degree are involved, multipath signal distortion occurs. The multipath signal causes antenna pattern distortion and inaccurate pointing.

Abstracts

A 94-GHz Radar for Space Object Identification (1969 [MWSYM])

L.A. Hoffman, K.H. Hurlbut, D.E. Kind and H.J. Wintroub. "A 94-GHz Radar for Space Object Identification (1969 [MWSYM])." 1969 G-MTT International Microwave Symposium Digest of Technical Papers 69.1 (1969 [MWSYM]): 475-484.

Theoretical studies at The Aerospace Corporation over the past several years, of the general radar resolution problem have been the stimulus for an experimental program aimed at demonstrating the practicability of utilizing the high inherent resolution potential of millimeter-wavelength radar. In brief, the large bandwidth available at 94 GHz, for example, (several thousand MHz) should enable a radar to obtain a "range profile" of a satellite that shows more details than range profiles at lower frequencies. The high Doppler sensitivity at 94 GHz should permit a precise measurement of the spin rate for spinning satellites; the high carrier frequency offers the possibility of using synthetic aperture processing to "compress" the antenna beam along the track, so that two-dimensional resolution in range and along the track is obtained for better determination of satellite properties.

Abstracts

Millimeter-Wave Systems Applications

W.O. Copeland, J.R. Ashwell, G.P. Kefalas and J.C. Wiltse. "Millimeter-Wave Systems Applications." 1969 G-MTT International Microwave Symposium Digest of Technical Papers 69.1 (1969 [MWSYM]): 485-488.

Several system applications are being developed at millimeter wavelengths, including: 1. Radiometric ship detection and missile guidance against ship targets. 2. Antenna systems for intersatellite relays. 3. Radar area correlator guidance and clutter suppression techniques. 4. Wideband propagation/communication experiments between a satellite and ground stations. The first two of these examples will be discussed in detail, while the latter two will only be briefly mentioned.

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Millimeter Radar Investigation

M.J. Foral. "Millimeter Radar Investigation." 1969 G-MTT International Microwave Symposium Digest of Technical Papers 69.1 (1969 [MWSYM]): 489-493.

In the field of scanning radar the need for high resolution is becoming increasingly important. Several types of monopulse techniques have been tried in order to improve angular resolution but results have been marginal. Higher angular resolution than that produced by the beam size of the system cannot be attained by monopulse methods. The most simple and perhaps the most effective method that can be used to achieve high resolution is through the use of a narrow antenna beam. The antenna beam can be made more narrow by either increasing the antenna size or increasing the radar frequency. In airborne applications the antenna size has reached a practical limit so, in order to improve the resolution, it becomes necessary to increase the radar frequency. For this reason a continuing investigation of the higher radar frequencies is being conducted at the Naval Air Development Center.

Abstracts

Index of Authors (1969 [MWSYM])

"Index of Authors (1969 [MWSYM])." 1969 G-MTT International Microwave Symposium Digest of Technical Papers 69.1 (1969 [MWSYM]): 494-505.

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Program Supplement, Late News Items, 1969 G-MTT International Microwave Symposium

"Program Supplement, Late News Items, 1969 G-MTT International Microwave Symposium." 1969 G-MTT International Microwave Symposium Digest of Technical Papers 69.1 (1969 [MWSYM]): 504-505.

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"Front Cover (1970 [MWSYM])." 1970 G-MTT International Microwave Symposium Digest of Technical Papers 70.1 (1970 [MWSYM]): f1-ii.

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Foreword (1970 [MWSYM])

S. Sensiper. "Foreword (1970 [MWSYM])." 1970 G-MTT International Microwave Symposium Digest of Technical Papers 70.1 (1970 [MWSYM]): iii-iii.

The Los Angeles G-MTT Chapter welcomes you to the 1970 IEEE G-MTT International Symposium. Our neighbor Chapters from Foothill and Orange County join us in this welcome.

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"Session MAM-I -- Microwave Integrated Circuits I." 1970 G-MTT International Microwave Symposium Digest of Technical Papers 70.1 (1970 [MWSYM]): 1-1.

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Thin Film Lumped Constant Microwave Integrated Filter Structures

G.D. Alley, L.F. Rago and J. Schill. "Thin Film Lumped Constant Microwave Integrated Filter Structures." 1970 G-MTT International Microwave Symposium Digest of Technical Papers 70.1 (1970 [MWSYM]): 2-6.

Lumped constant circuits containing thin film inductors and interdigital capacitors have been evaluated thru S band. The measured results are in good agreement with computer predictions. A lumped L band 3 dB directional coupler with 0.4 dB insertion loss and an 18% bandwidth, a lumped 9 section S band low pass filter with less than 1 dB insertion loss and a pseudo lumped 5 section 2.3% bandwidth bandpass filter are discussed.

Abstracts

Interdigital Capacitors for Use in Lumped-Element Microwave Integrated Circuits

G.D. Alley. "Interdigital Capacitors for Use in Lumped-Element Microwave Integrated Circuits." 1970 G-MTT International Microwave Symposium Digest of Technical Papers 70.1 (1970 [MWSYM]): 7-13.

An analysis of the frequency response of interdigital capacitors is given along with an equation for their design. The capacitor Q is given in terms of its geometry which consists of a planar interdigital conductor deposited on the surface of a substrate. Capacitance values ranging from 0.1 to 10 pF at L band with measured Q's in excess of 400 are realizable.

Abstracts

Lumped-Elements in Microwave Integrated Circuits in the 1-12 GHz Range

R. DeBrecht and M. Caulton. "Lumped-Elements in Microwave Integrated Circuits in the 1-12 GHz Range." 1970 G-MTT International Microwave Symposium Digest of Technical Papers 70.1 (1970 [MWSYM]): 14-18.

Lumped elements have found increasing use in microwave integrated circuits at low UHF and S-band frequencies. At this laboratory they have been used in various circuits such as filters, quadrature hybrids, and impedance matching networks for high-power transistor amplifiers. Limiting the use of lumped elements has been: (1) the uncertainties of the reactance and Q's of the elements at frequencies above 2.5 GHz, and (2) the difficulty of fabricating the high-Q components necessary for large impedance transformations to low-impedance active devices. The past difficulty in measuring the reactance and Q values above S-band has been the unavailability of a measurement system at high frequencies that is compatible with the size of the element. However, suitable resonant techniques have now been developed for frequencies from 1 to 12 GHZ. Lumped inductors and capacitors fabricated at this Iaboratory have been measured by these new techniques. The results demonstrate that high-Q capacitors have been achieved by recent improvements in thin-film dielectric processing, and that capacitors and single-turn inductors are "truly lumped" through 10 GHz.

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The Application of Dielectric Resonators to Microwave Integrated Circuits

P. Clar. "The Application of Dielectric Resonators to Microwave Integrated Circuits." 1970 G-MTT International Microwave Symposium Digest of Technical Papers 70.1 (1970 [MWSYM]): 19-23.

The dialectric resonator is the electromagnetic dual of the metal cavity resonator and has the advantage that miniaturization is achieved by dielectric loading without the corresponding reduction of Q, characteristic of metal cavities and transmission line resonators. This makes them an ideal candidate, when less temperature sensitive materials become available, to fill the need for a low cost, integratable, high Q, metal cavity replacement for microwave integrated circuit (MIC) applications. Considerable investigation of dielectric resonators has been done in waveguide structures. This paper presents design and fabrication techniques for incorporating them into MICs. External and mutual coupling coefficients are determined for C-Band rutile resonators mounted on MIC circuits and coupled to MIC microstrip lines. The effect of packaging on spurious transmission is shown. The performance of a C-Band multipole rutile resonator MIC bandpass filter is described. A simple tuning technique is also demonstrated.

Abstracts

Dielectric Resonators as Microstrip Circuit Elements

W.R. Day, Jr.. "Dielectric Resonators as Microstrip Circuit Elements." 1970 G-MTT International Microwave Symposium Digest of Technical Papers 70.1 (1970 [MWSYM]): 24-28.

Dielectric resonators may be used as hybrid circuit elements in microstrip transmission line circuits. These resonators may function as bandpass filters, bandstop filters, passive stabilization cavities for solid-state diode oscillators, or as reference cavities for Pound discriminators. Dielectric resonators are small size and high Q which makes them desirable for microstrip circuits where deposited resonators are large at lower microwave frequencies and have limited Q's. The purpose of this paper is to present a simple design procedure for cylindrical TiO/sub 2/ resonators on microstrip and to illustrate the use of such a resonator in a practical Pound discriminator circuit.

Abstracts

A Parallel Coupled Microstrip Filter Design Procedure

R.A. Dell-Imagine. "A Parallel Coupled Microstrip Filter Design Procedure." 1970 G-MTT International Microwave Symposium Digest of Technical Papers 70.1 (1970 [MWSYM]): 29-32.

The increased use of microstrip transmission line for miniaturized printed microwave circuits has created a demand for a compact filter structure compatible with microstrip. The parallel coupled filter circuits developed by Cohn are very compact, but his design procedure does not apply to microstrip which has different even and odd mode velocities. This paper develops the theoretical analysis to compensate Cohn's procedure for even and odd mode velocity differences and develops design curves which permit the determination of the circuit geometry from the parameter K/Z/sub o/. The results only apply to filters with 50 Omega impedance on 99.5% alumina substrates, but they can easily be generalized to other impedances.

Abstracts

A High Directivity Microstrip Coupler Technique

A. Podell. "A High Directivity Microstrip Coupler Technique." 1970 G-MTT International Microwave Symposium Digest of Technical Papers 70.1 (1970 [MWSYM]): 33-36.

Typically loosely coupled backward wave microstrip couplers have directivities which decrease with increasing frequency. High directivity becomes more difficult to obtain as the coupling is loosened. The problem appears to be that the propagating velocities of the odd and even modes are not equal. This paper deals with a technique which equalizes these velocities up to an arbitrarily high frequency.

Abstracts

Session MAM-II -- Diffraction

"Session MAM-II -- Diffraction." 1970 G-MTT International Microwave Symposium Digest of Technical Papers 70.1 (1970 [MWSYM]): 37-37.

Abstracts

The Diffraction of Electromagnetic Waves by Dielectric Steps in Waveguides (1970 [MWSYM])

E.G. Royer and R. Mittra. "The Diffraction of Electromagnetic Waves by Dielectric Steps in Waveguides (1970 [MWSYM])." 1970 G-MTT International Microwave Symposium Digest of Technical Papers 70.1 (1970 [MWSYM]): 38-42.

The electromagnetic scattering from dielectric steps in waveguides is investigated using a new method based upon an extension of the modified residue calculus techniques. The major advantages of the method are its numerical efficiency and accuracy and that these characteristics are sustained at high frequencies as well as high permittivities.

Abstracts

Ray-Optical Diffraction Coefficients for Waveguide Discontinuity Problems

A. Mohsen and M.A.K. Hamid. "Ray-Optical Diffraction Coefficients for Waveguide Discontinuity Problems." 1970 G-MTT International Microwave Symposium Digest of Technical Papers 70.1 (1970 [MWSYM]): 43-44.

The ray optical technique has proved its computational advantages in high frequency scattering by objects in unbounded media and has only been recently applied to waveguide problems. Besides its simplicity, the method is surprisingly accurate in the short wavelength range and gives a physical insight into various complex propagation and diffraction mechanisms, Yee, Felsen and Keller used this technique to treat the reflection from an open-ended parallel plate waveguide. Later, Yee and Felsen solved the corresponding vector case for rectangular and circular waveguides. The agreement between theory and experiment was naturally better for shorter wavelengths. Yee and Felsen also treated waveguide discontinuities such as strips and bifurcation using the same technique. An excellent agreement with the exact solutions, whenever possible, was noted in the multimode range with less accuracy in the range of propagation of the dominant mode and inaccurate results in the vicinity of the modal cut-offs. In order to improve the accuracy of the technique, a more accurate "near field" diffraction coefficient is necessary.

Abstracts

On the Restricted Validity of Point-Matching Techniques (1970 [MWSYM])

L. Lewin. "On the Restricted Validity of Point-Matching Techniques (1970 [MWSYM])." 1970 G-MTT International Microwave Symposium Digest of Technical Papers 70.1 (1970 [MWSYM]): 45-48.

Numerical calculation based on point-matching of electromagnetic fields can give accurate results, but the validity of the method depends on a basic formulation involving a complete expansion set for the fields. The validity of the so-called "Rayleigh Hypothesis", which attempts to avoid this issue by an analytic continuation of expressions for the fields, is questioned.

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A Focused Aperture Millimeter Wave Transmission Line

C.O. Yowell. "A Focused Aperture Millimeter Wave Transmission Line." 1970 G-MTT International Microwave Symposium Digest of Technical Papers 70.1 (1970 [MWSYM]): 49-54.

Design details are presented for an open waveguide radar transmission line. This 94 GHz quasi-optical guide is presently in use at The Aerospace Corporation Laboratories, with two focusing mirrors and offset reeds providing power transfer and rotary joint action for a scanning 15' diameter parabolic antenna. Experimental results are given for the beam shapes, phase contours, insertion loss, and isolation of the beam guide.

Abstracts

Session MAM-III -- Late News Items

"Session MAM-III -- Late News Items." 1970 G-MTT International Microwave Symposium Digest of Technical Papers 70.1 (1970 [MWSYM]): 55-55.

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Session MPM-I -- Microwave Filters and Couplers

"Session MPM-I -- Microwave Filters and Couplers." 1970 G-MTT International Microwave Symposium Digest of Technical Papers 70.1 (1970 [MWSYM]): 56-56.

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Abstracts

Microwave Applications of the Bridged T

F.S. Coale, T.C. Cisco and R.B. Mouw. "Microwave Applications of the Bridged T." 1970 G-MTT International Microwave Symposium Digest of Technical Papers 70.1 (1970 [MWSYM]): 57-61.

With the advent of microwave integrated circuits many circuits which have been discarded in the early days of microwave theory and techniques are finding new applications. The bridged-T has been used for years in low frequency applications as attenuators. It actually is a much more general network and possesses some features which have not been utilized. Figure 1 shows a typical bridged T with a generator and load at Z/sub 0/.

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Subminiature Microwave Active Filter Manifolds

R.Y.C. Ho and B. Battensby. "Subminiature Microwave Active Filter Manifolds." 1970 G-MTT International Microwave Symposium Digest of Technical Papers 70.1 (1970 [MWSYM]): 62-65.

In May 1968, a new active filter technique was reported to be suitable for UHF and microwave applications. A previously unexploited transistor mechanism, associated with the transit time properties of a transistor, is found to yield stable inductance with extremely high Q, or even negative Q; thus allowing a single transistor to be substituted for an inductor in conventional filter designs. Alternately, one transistor can be coupled to each filter resonator to raise its Q. As a result, microwave active filters can be made extremely small without insertion loss or selectivity degradation. For example, the volume per resonator of recent UHF filter designs is approximately 0.1 cubic inches. Subminiature active filters have been tested at frequencies ranging from low-VHF to S-band. Accomplishing a significant reduction in filter size makes possible a number of useful systems, such as lossless multiplexer with large numbers of contiguous filter channels. The ability to divide a frequency band into a large manifold of adjacent channels is a useful aid in the accurate processing of broad-bandwidth signals. The purpose of this paper is to present recent development in active filter designs with remarkably improved filter performance, and to discuss the application of active filter techniques to microwave frequency multiplexing.

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Abstracts

Small Elliptic-Function Lowpass Filters

R.J. Wenzel. "Small Elliptic-Function Lowpass Filters." 1970 G-MTT International Microwave Symposium Digest of Technical Papers 70.1 (1970 [MWSYM]): 66-70.

A type of elliptic-function filter is described that is easy to design and construct, has low passband loss, and is very compact. With simple scaling, a broad range of cutoff frequencies can be obtained with a limited number of standard parts. Experimental results are presented for three filters with cutoff frequencies of 0.75, 1.0, and 1.5 GHz. Each filter occupies a volume of about 0.5 in/sup3/.

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Zolotarev Functions, A New Distributed Prototype Filter, and the Design of Mixed Lumped/Distributed Components

R. Levy. "Zolotarev Functions, A New Distributed Prototype Filter, and the Design of Mixed Lumped/Distributed Components." 1970 G-MTT International Microwave Symposium Digest of Technical Papers 70.1 (1970 [MWSYM]): 71-75.

The theory and applications of Chebyshev functions are familiar in microwaves, circuit theory, and other fields. Less well known are the extensions of Chebyshev's theory by his student E. Zolotarev, whose work was described in detail and extended by Achieser. Some of these results have been found useful in the solution of certain problems in both distributed and mixed lumped/distributed component design. As originally presented, Zolotarev functions involve higher-order elliptic functions and require a good deal of interpretation and simplification, which has now been carried out. Several new results have been obtained, and the application to microwave component design, indeed possibly to any field of engineering, is probably novel.

Abstracts

Synthesis of Multi-Section Networks Using the W-Plane

M.C. Horton. "Synthesis of Multi-Section Networks Using the W-Plane." 1970 G-MTT International Microwave Symposium Digest of Technical Papers 70.1 (1970 [MWSYM]): 76-84.

A new calculation technique is presented to minimize roundoff errors that occur in network synthesis of microwave TEM components. Both approximation and synthesis are accommodated in the complex W-plane, transformed from Richards' S = tanh (pi(s))/(2(omega/sub 0/)) plane. The new technique has been applied to non-redundant bands top filters, to interdigital bandpass filters, and to diplexing filters. Results of calculations indicate that filters and other TEM components having two to three times as many elements can be synthesized in the W-plane as compared to similar calculations performed in the S-plane. The new method is particularly useful in the synthesis of complementary or pseudo-complementary diplexers.

Abstracts

Compact Multiplexing Networks for L-Band through K/sub U/-Band

R.J. Wenzel. "Compact Multiplexing Networks for L-Band through K/sub U/-Band." 1970 G-MTT International Microwave Symposium Digest of Technical Papers 70.1 (1970 [MWSYM]): 85-89.

Techniques for the design and construction of compact multiplexing filters with minimum complexity, size, and loss are presented. The practicality and limitations of several types of filter forms at high microwave frequencies are demonstrated. Experimental results for four compact multiplexing networks covering L-band through K/sub U/-band are given.

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A Four-Cavity Elliptic Waveguide Filter (1970 [MWSYM])

A.E. Williams. "A Four-Cavity Elliptic Waveguide Filter (1970 [MWSYM])." 1970 G-MTT International Microwave Symposium Digest of Technical Papers 70.1 (1970 [MWSYM]): 90-93.

This paper describes how the bandpass fourth-order antimetric-elliptic-filter function can be synthesized in a waveguide structure. A mathematical model is shown to predict accurately the performance of an experimental waveguide filter.

Abstracts

Session MPM-II -- Millimeter Waves

"Session MPM-II -- Millimeter Waves." 1970 G-MTT International Microwave Symposium Digest of Technical Papers 70.1 (1970 [MWSYM]): 94-94.

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An 18 GHz Double-Tuned Parametric Amplifier (1970 [MWSYM])

Y. Kinoshita and M. Maeda. "An 18 GHz Double-Tuned Parametric Amplifier (1970 [MWSYM])." 1970 G-MTT International Microwave Symposium Digest of Technical Papers 70.1 (1970 [MWSYM]): 95-99.

This paper describes a Ku-band nondegenerate parametric amplifier, using a new type of idler choke and a simple resonator, that exibits a nearly flat bandwidth of 550 MHz at 20 dB gain and a noise temperature of 280°K at room temperature ambient.

Abstracts

K-Band, Cryogenically Cooled, Wideband Nondegenerate Parametric Amplifier

S. Takahashi, M. Nojima, T. Fukuda and A. Yamada. "K-Band, Cryogenically Cooled, Wideband Nondegenerate Parametric Amplifier." 1970 G-MTT International Microwave Symposium Digest of Technical Papers 70.1 (1970 [MWSYM]): 100-103.

System design of satellite communications utilizing millimeter wavelength is being studied. It is most probable that the down link frequency will be between 15 and 20 GHz. That system will require wideband, low noise (around 100 °K) amplifiers at the earth stations. Only cooled nondegenerate parametric amplifiers are able to meet requirements. But bandwidths and noise temperatures of those amplifiers already reported on in this band were several tens of MHz and several hundred degrees Kelvin, respectively. This paper describes design and performance of a cryogenically cooled, wideband (600 MHz), low noise (100 °K) nondegenerate parametric amplifier.

Abstracts

Parametric Amplification of Millimeter and Submillimeter Waves: Results, Potentials and Limitations

J. Edrich. "Parametric Amplification of Millimeter and Submillimeter Waves: Results, Potentials and Limitations." 1970 G-MTT International Microwave Symposium Digest of Technical Papers 70.1 (1970 [MWSYM]): 104-110.

In the past parametric amplification was limited to microwave frequencies, as varactors did not reach high enough cutoff frequencies and low enough parasitic reactance. Recently Au-GsAs Schottky Barrier junctions with cutoff frequencies f/sub c/ beyond 1000 GHz mounted in Sharpless-wafers have opened the mm-wave region for this device.

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Abstracts

Millimeter-Wave Mode Conversion by a Solid-State Magnetoplasma

K.S. Champlin and G.H. Glover. "Millimeter-Wave Mode Conversion by a Solid-State Magnetoplasma." 1970 G-MTT International Microwave Symposium Digest of Technical Papers 70.1 (1970 [MWSYM]): 111-113.

Solid-state magnetoplasma devices have been recently proposed as phase-shifters, isolators, filters, and circulators for use at millimeter and sub-millimeter wavelengths. We herewith report observations of phenomena indicating that magnetoplasmas can also be utilized to efficiently transduce millimeter and submillimeter energy from one waveguide mode to another present microwave devices which accomplish this function are mechanical in nature and are thus subject to wavelength limitations imposed by dimensional tolerances. Besides circumventing such limitations, magnetoplasma mode-conversion devices have the additional advantage of being magnetically controllable. In the present paper, we consider one-port conversion from the circular TE/spl circle/ /sub 01/ mode to the circular TM/spl circle//sub 01/ mode. The basic principle is, however, also applicable to two-port conversion and to several other choices of waveguide geometry and mode-pair.

Abstracts

A PIN Diode for mm-Wave Digital Modulation

W.O. Schlosser, J.P. Beccone and R.S. Riggs. "A PIN Diode for mm-Wave Digital Modulation." 1970 G-MTT International Microwave Symposium Digest of Technical Papers 70.1 (1970 [MWSYM]): 114-117.

The object of this paper is to show that a switch using PIN diodes is especially well suited for mm-wave high speed digital modulation. The PIN diodes to be described have a switching speed of less than 0.7 nsec and a power handling capability in excess of 200 mW. The quoted switching speed is realized with a transistorized driver consuming 0.8W. The switching quality factor Q of the PIN diodes is approximately 40 at 55 GHz-including the loss in the diode mount.

Abstracts

Session MPM-III -- Microwave Imaging

"Session MPM-III -- Microwave Imaging." 1970 G-MTT International Microwave Symposium Digest of Technical Papers 70.1 (1970 [MWSYM]): 118-118.

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EMC Technology, Inc. (Advertisement) (1970 [MWSYM])

"EMC Technology, Inc. (Advertisement) (1970 [MWSYM])." 1970 G-MTT International Microwave Symposium Digest of Technical Papers 70.1 (1970 [MWSYM]): 119-119.

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Microwave Holography

W.E. Kock. "Microwave Holography." 1970 G-MTT International Microwave Symposium Digest of Technical Papers 70.1 (1970 [MWSYM]): 120-123.

Several recent publications have described applications of holography in the microwave field, and one of these listed numerous references. This paper reviews early microwave hologram efforts and also reports on several recent developments.

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Binary, Detour Phase, Microwave Holography

G. Tricoles and E.L. Rope. "Binary, Detour Phase, Microwave Holography." 1970 G-MTT International Microwave Symposium Digest of Technical Papers 70.1 (1970 [MWSYM]): 124-125.

The concept of detour phase has been previously used as a basis for computer-generated holograms. This paper describes the application of detour phase to produce optical holograms from microwave measurements.

Abstracts

Millimeter Wave Imaging

B.R. Feingold and B.J. Levin. "Millimeter Wave Imaging." 1970 G-MTT International Microwave Symposium Digest of Technical Papers 70.1 (1970 [MWSYM]): 126-130.

A millimeter wave imaging system using a semiconductor panel as an image dissector has been evaluated at 80 GHz and 140 GHz using both optomechanical and electron beam scanning methods. Images of groups of simple reflecting targets were found easily resolvable at separations approaching the theoretical minimum.

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Session TAM-I -- Computer-Oriented Microwave Practices

"Session TAM-I -- Computer-Oriented Microwave Practices." 1970 G-MTT International Microwave Symposium Digest of Technical Papers 70.1 (1970 [MWSYM]): 131-131.

Abstracts

Current Trends in Automated Network Design Optimization

J.W. Bandler. "Current Trends in Automated Network Design Optimization." 1970 G-MTT International Microwave Symposium Digest of Technical Papers 70.1 (1970 [MWSYM]): 132-133.

There is still a widely held view that the modern, high-speed, large storage digital computer is most effectively utilized as a tool for analysis, and that most, if not all, decisions (even routine decisions) relating to optimal design are best left to the engineer himself. One reason for this view may arise out of the engineer's apprehension of a machine taking over the decision making process altogether. An alternative one may be that his system is so complex that even one analysis requires considerable effort. On a more mundane level, it may be that the engineer is so imbued by manual cut-and-try techniques as used in the laboratory under his control that he cannot envisage the possibility of fully automated design. Even the classicist must ultimately substitute numbers into his "exact" or "closed-form" solutions. It is probably some combination of such reasons that is inspiring the proliferation of effort devoted to the writing and implementing of general purpose circuit analysis programs.

Abstracts

Computation of Sensitivities for Optimal Design of Microwave Networks

J.W. Bandler and R. Seviora. "Computation of Sensitivities for Optimal Design of Microwave Networks." 1970 G-MTT International Microwave Symposium Digest of Technical Papers 70.1 (1970 [MWSYM]): 134-137.

In recent contributions, Director and Rohrer discussed the concept of the adjoint network and its relevance to automated design of networks in the frequency and time domains. Employing Tellegen's theorem they demonstrated how the gradient vector for a least squares type of response objective function with respect to all existing (and nonexisting, if desired) elements could be evaluated from only two complete analyses, one of the given network and one of its topologically equivalent adjoint network. In the frequency domain they considered both reciprocal and nonreciprocal lumped, linear and time invariant elements. More recently, it was shown how their approach could be implemented for least pth and minimax response objective functions.

Abstracts

An Application of Razor Search to Semi-Lumped Networks

B.W. Leake. "An Application of Razor Search to Semi-Lumped Networks." 1970 G-MTT International Microwave Symposium Digest of Technical Papers 70.1 (1970 [MWSYM]): 138-140.

A great deal of work has been published on the design of broadband matching networks between fixed dissimilar impedances. Quarter-wave transformers and lumped-element low-pass filters have been analyzed thoroughly.

Abstracts

Computer-Aided Design Optimization of Broadband Stripline Y-Circulators

S. Okamura and T. Nagai. "Computer-Aided Design Optimization of Broadband Stripline Y-Circulators." 1970 G-MTT International Microwave Symposium Digest of Technical Papers 70.1 (1970 [MWSYM]): 141-144.

A number of papers have been given concerning the design of below-resonance stripline circulators, which are characterized by their broadband behaviour. However, considerable disagreements still exist between theory and experiment. For instance no existing theory seems to be consistent with an empirically designed octaveband circulator.

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EHPOL: An Analysis Program for the Arbitrarily Shaped Waveguide

R.M. Bulley. "EHPOL: An Analysis Program for the Arbitrarily Shaped Waveguide." 1970 G-MTT International Microwave Symposium Digest of Technical Papers 70.1 (1970 [MWSYM]): 145-149.

A description is given of the theory and application of a computer program called EHPOL which produces both E and H waveguide modes by polynomial approximation. Results indicate that for the analysis of convex guides the program is probably the best available from viewpoints of both speed and accuracy.

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Finite Element Solution of Dielectric Loaded Waveguides

P. Silvester and Z. Csendes. "Finite Element Solution of Dielectric Loaded Waveguides." 1970 G-MTT International Microwave Symposium Digest of Technical Papers 70.1 (1970 [MWSYM]): 150-155.

Despite the widespread use of dielectric loaded waveguides in microwave components, their basic electrical properties are, in general, theoretically unknown. Analytic solution is prohibited, except for a few simple geometries, by the difficulty of matching electric and magnetic fields at the air-dielectric interface; consequently, recent efforts to find a solution have employed numerical methods. In this paper, the finite element method will be applied in an unrestricted sense to inhomogeneous waveguides and some computed results will be presented.

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A Finite Difference, First-Order Perturbation Method for Attenuation in Arbitrarily Shaped Waveguides

M.J. Beaubien and A. Wexler. "A Finite Difference, First-Order Perturbation Method for Attenuation in Arbitrarily Shaped Waveguides." 1970 G-MTT International Microwave Symposium Digest of Technical Papers 70.1 (1970 [MWSYM]): 156-159.

The simplest and most frequently used method employed in the calculation of waveguide wall losses proceeds as follows: (1) solve the electromagnetic field under the assumption that the walls are perfectly conducting; (2) calculate the wall currents through knowledge of the magnetic field tangential to the wall; (3) square the current, at each point on the conductor surface, and multiply by the equivalent resistance due to skin effect R/sub s/ = /spl radic/ omega/μ/sub o/ / 2sigma; and (4) integrate over the entire surface to obtain the total power loss. Note that the initial assumption of perfectly conducting walls excludes six-component hybrid fields from consideration --- which, in fact, must exist.

Abstracts

Session TAM-II -- Oscillator Noise and Stabilization

"Session TAM-II -- Oscillator Noise and Stabilization." 1970 G-MTT International Microwave Symposium Digest of Technical Papers 70.1 (1970 [MWSYM]): 160-160.

Abstracts

Noise Properties and Stabilization of Gunn and Avalanche Diode Oscillators and Amplifiers

J.R. Ashley and F.M. Palka. "Noise Properties and Stabilization of Gunn and Avalanche Diode Oscillators and Amplifiers." 1970 G-MTT International Microwave Symposium Digest of Technical Papers 70.1 (1970 [MWSYM]): 161-164.

Figures 1 and 2 give the FM and AM noise of typical X-Band and Gunn and avalanche diode oscillators. These data are typical and not essentially different from the early data presented by Josenhans. Most differences in the FM noise can be explained by the changes in circuit Q with great reduction in the FM noise obtained only by increasing the circuit Q by energy storage in an additional stabilizing cavity. Differences in AM data can usually be accounted for by the bias circuit impedance or by threshold problems in the AM noise measurement equipment. This is particularly true for the Gunn diode oscillator because the AM noise is low enough that only a Schottky barrier diode is capable of making the measurement.

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Abstracts

Circuit Design for Minimizing the FM Noise of a CW Gunn Oscillator

A.A. Sweet. "Circuit Design for Minimizing the FM Noise of a CW Gunn Oscillator." 1970 G-MTT International Microwave Symposium Digest of Technical Papers 70.1 (1970 [MWSYM]): 165-165.

The FM noise spectrum of a Gunn diode operated in any microwave circuit may be calculated from three noise parameters and the results of simple microwave measurements. These three noise parameters, one describing thermal noise properties and two describing flicker noise properties are assigned to each diode as a result of noise measurements made in a standard test circuit.

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Feedback Control Analysis of Microwave Oscillator Stabilization with a Transmission Cavity

J.G. Ondria and T.R. Turlington. "Feedback Control Analysis of Microwave Oscillator Stabilization with a Transmission Cavity." 1970 G-MTT International Microwave Symposium Digest of Technical Papers 70.1 (1970 [MWSYM]): 166-169.

This paper shows cavity stabilization of microwave oscillators can be characterized by a Type O (AFC) servomechanism. Stabilized phase noise spectral density can now be analyzed as a function of modulation rate. Measured phase noise data of stabilized IMPATT and Gunn oscillators are compared with the new theory.

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Highly Stabilized Half-Watt IMPATT Oscillator (1970 [MWSYM])

S. Nagano. "Highly Stabilized Half-Watt IMPATT Oscillator (1970 [MWSYM])." 1970 G-MTT International Microwave Symposium Digest of Technical Papers 70.1 (1970 [MWSYM]): 170-173.

Microwave solid state oscillators such as IMPATT and Gunn oscillators are coming into practical uses. These are very impressive devices, but having several practical problems. They include insufficient frequency stability for temperature variations, insufficient output power level as a transmitter oscillator, and higher noise level. Currently, the output power level of commercially available IMPATT diodes are improving, and more than several watts is obtainable in laboratory. If the frequency stability and noise problems are solved without much increasing the oscillator size, the IMPATT oscillator can replace conventional oscillators in many applications.

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Cavity Stabilized X-Band Gunn Oscillator (1970 [MWSYM])

Y. Ito, H. Komizo and S. Sasagawa. "Cavity Stabilized X-Band Gunn Oscillator (1970 [MWSYM])." 1970 G-MTT International Microwave Symposium Digest of Technical Papers 70.1 (1970 [MWSYM]): 174-178.

To obtain the highly stable and low noise gunn or avalanche diode oscillator, there are two methods, the one is an injection locking to a master oscillator and the other is a cavity stabilization.

Abstracts

Measurement of the Noise in a Linear Two-Port Device

G.A. Deschamps, F.R. Ore and J.J. Sweeney. "Measurement of the Noise in a Linear Two-Port Device." 1970 G-MTT International Microwave Symposium Digest of Technical Papers 70.1 (1970 [MWSYM]): 179-182.

It is well known that the noise factor of a linear two-port depends on the impedance (or reflectance) of the source connected to it. This is easily understood if the noise sources inside the device are replaced by equivalent amplitude sources, one at each port. These sources produce outward traveling waves which are, in general, partially correlated. Thus if the wave at port 1 is reflected by the source mismatch it will interfere with the wave at 2 in a manner that depends on the source reflectance W.

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Session TPM -- Microwave Integrated Circuits II

"Session TPM -- Microwave Integrated Circuits II." 1970 G-MTT International Microwave Symposium Digest of Technical Papers 70.1 (1970 [MWSYM]): 183-183.

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A New Class of Microstrip Directional Couplers

F.C. de Ronde. "A New Class of Microstrip Directional Couplers." 1970 G-MTT International Microwave Symposium Digest of Technical Papers 70.1 (1970 [MWSYM]): 184-189.

By using Cohn's slotline in combination with a microstrip, simple 90° as well as 180° directional couplers of any coupling value can be made. As examples an ultra flat 10 db coupler for 1 - 12 GHz, an octave wide (2 - 4 GHz) magic tee and an almost lumped proximity coupler for 2 - 8 GHz (all on alumina substrate) have been made.

Abstracts

Slot Line Filters

E. Mariani and J.P. Agrios. "Slot Line Filters." 1970 G-MTT International Microwave Symposium Digest of Technical Papers 70.1 (1970 [MWSYM]): 190-195.

The slot transmission line on high dielectric constant substrates provides a microwave medium for fabricating microwave filters that could have application to integrated circuits. Specifically, configurations which yield band-pass and band-stop filter characteristics are being investigated; coupling data has been obtained and several experimental filters have been constructed. The investigation was performed at frequencies near 3 GHz using circuits fabricated primarily on 0.063 inch thick, Trans Tech D-16, substrate material. The substrates were metallized using either aluminum sensing tape (3M No. 51) or using a combination of electroless and electroplating in order to deposit copper to a thickness of approximately 0.001 inch.

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Abstracts

Recent Developments in Microwave Slot-Line Mixers and Frequency Multipliers

J.K. Hunton and J.S. Takeuchi. "Recent Developments in Microwave Slot-Line Mixers and Frequency Multipliers." 1970 G-MTT International Microwave Symposium Digest of Technical Papers 70.1 (1970 [MWSYM]): 196-199.

A new type of planar balanced circuit, suitable for the realization of broadband microwave mixers and frequency multipliers, in integrated circuit form, was described in September 1969. In this circuit, a hybrid junction was formed by joining a slot transmission line and a coplanar transmission line. Four diodes were connected at the junction in the form of a ring to realize a balanced mixer.

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Wideband X-Band Microstrip Image Rejection Balanced Mixer

G.P. Kurpis and J.J. Taub. "Wideband X-Band Microstrip Image Rejection Balanced Mixer." 1970 G-MTT International Microwave Symposium Digest of Technical Papers 70.1 (1970 [MWSYM]): 200-205.

This paper describes a wideband X-band image rejection mixer constructed in microstrip using a thin-glazed alumina substrate. This mixer has a 10 to 11.3 dB noise figure and over 20-dB image rejection over an 8 to 12 GHz frequency band. Image rejection is achieved by using a pair of balanced mixers with signal and LO voltages fed in quadrature and in phase, respectively. Such circuits have been previously constructed in waveguide and conventional strip transmission line; the microstrip mixer described herein achieves comparable electrical performance in a much smaller volume and weight than X-band designs developed in these other transmission media.

Abstracts

Low Noise Microstrip Mixer on a Plastic Substrate

B.R. Hallford. "Low Noise Microstrip Mixer on a Plastic Substrate." 1970 G-MTT International Microwave Symposium Digest of Technical Papers 70.1 (1970 [MWSYM]): 206-211.

The availability of high dielectric constant substrates with superior electrical and physical properties is credited with the revival of microstrip designs. This paper demonstrates that it is also possible to successfully design microstrip circuits on metal clad plastic materials that have a low dielectric constant.

Abstracts

Beam Lead Tunnel Diode Amplifiers on Microstrip (1970 [MWSYM])

J.D. Welch. "Beam Lead Tunnel Diode Amplifiers on Microstrip (1970 [MWSYM])." 1970 G-MTT International Microwave Symposium Digest of Technical Papers 70.1 (1970 [MWSYM]): 212-216.

In terms of the number of components, the tunnel diode amplifier is one of the least complex RF amplifiers available. It has never achieved broad acceptance because of high cost, poor reliability, and problems of instability. The recent success of planar fabrication techniques promises to eliminate these drawbacks. By integrating planar tunnel diodes with printed microwave circuitry, reliable low-cost, high-performance tunnel diode amplifiers should be feasible.

Abstracts

A Microminiature Monoscan-Converter for Use in Tracking Antenna Systems

J.J. Stitt, C.V. Bell and G.I. Tsuda. "A Microminiature Monoscan-Converter for Use in Tracking Antenna Systems." 1970 G-MTT International Microwave Symposium Digest of Technical Papers 70.1 (1970 [MWSYM]): 217-220.

Many methods have been devised to achieve accurate tracking capability in antenna systems. The sequential lobing technique was one of the earliest methods and was commonly used in early airborne-interceptor radar. Sequential lobing provides angle tracking information via amplitude comparisons between time shared antenna beam positions. This method has now been largely replaced by conical scan and monopulse tracking techniques. Conical scanning is achieved by mechanical or electrical rotation of the antenna beam axis. The output amplitude is then analyzed to provide directional error signals. The monopulse technique uses multiple, simultaneous beams to provide complete angular tracking information in real time.

Abstracts

The Microwave Engineer and the Computer (Panel Discussion)

"The Microwave Engineer and the Computer (Panel Discussion)." 1970 G-MTT International Microwave Symposium Digest of Technical Papers 70.1 (1970 [MWSYM]): 221-221.

The session will consist of a LIVE Computer Demonstration and a free-wheeling panel discussion ranging over the following questions: 1. What software requirements does the practicing engineer have? 2. What do we mean by computer aided design? 3. Has the closed form solution any relevance in the algorithmic age? Participants are invited to demonstrate their own program on the time sharing terminal that will be available. The audience will watch the output displayed on T.V. monitors. Those interested in demonstrating their program should contact the Session Organizer as soon as possible so that adequate provisions can be made.

Abstracts

Applications of Microwave Integrated Circuits (Panel Discussion)

"Applications of Microwave Integrated Circuits (Panel Discussion)." 1970 G-MTT International Microwave Symposium Digest of Technical Papers 70.1 (1970 [MWSYM]): 221-221.

The purpose of this panel is to discuss some of the most recent applications of microwave integrated circuits in the design of microwave components and systems. The basic questions to be answered are (1) what are some of the real and practical applications of MIC's today, and (2) what applications are planned for the immediate future?

Abstracts

Session WAM-I -- Gunn Effect Devices

"Session WAM-I -- Gunn Effect Devices." 1970 G-MTT International Microwave Symposium Digest of Technical Papers 70.1 (1970 [MWSYM]): 222-222.

Abstracts

Progress in Gunn Devices (No Text)

L.A. MacKenzie. "Progress in Gunn Devices (No Text)." 1970 G-MTT International Microwave Symposium Digest of Technical Papers 70.1 (1970 [MWSYM]): 223-223.

Abstracts

High Power Gunn Oscillator Diodes on Type-IIA Diamond Heat Sinks

M. Migitaka, M. Miyazaki and K. Saito. "High Power Gunn Oscillator Diodes on Type-IIA Diamond Heat Sinks." 1970 G-MTT International Microwave Symposium Digest of Technical Papers 70.1 (1970 [MWSYM]): 224-226.

It has been reported that a parallel connected silicon avalanche oscillator produced 4.7 Watts of CW power at 13.3 GHz. The improved performance of this oscillator resulted from the reduction of the thermal resistance between a wafer and heat sink using a parallel connection of wafers on a diamond pellet. The thermal conductivity of type-IIa diamond has been reported to exceed that of copper. In this report, the type-IIa diamond has been applied to the heat sink of a Gunn oscillator diode in order to reduce the thermal spreading resistance under the wafer of the diode. And a single Gunn oscillator diode with high power output over 600 mW has been developed.

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Linear Microwave Solid State Transferred Electron Power Amplifiers with a Large Gain-Bandwidth Product

B.S. Perlman and R.E. Marx. "Linear Microwave Solid State Transferred Electron Power Amplifiers with a Large Gain-Bandwidth Product." 1970 G-MTT International Microwave Symposium Digest of Technical Papers 70.1 (1970 [MWSYM]): 227-229.

In this paper we shall describe recent results with reflection type wide band solid state power amplifiers which show promise of replacing tubes in many microwave systems. These amplifiers are fabricated from epitaxial GaAs transferred electron devices which are stabilized through the use of low impedance circuits to form stable wideband linear cw amplifiers. Output powers in C-band of more than 250 mW over a 1 dB bandwidth of 3 GHz with a gain of 7 dB have been achieved. Saturated power outputs of 1 watt with 3 dB gain have also been achieved. In X-band, power outputs of over 150 mW over a 2 GHz bandwidth with 4 dB has been achieved.

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Direct Observation of LSA-Relaxation Oscillations in Bulk Gallium Arsenide Diodes

R. Spitalnik. "Direct Observation of LSA-Relaxation Oscillations in Bulk Gallium Arsenide Diodes." 1970 G-MTT International Microwave Symposium Digest of Technical Papers 70.1 (1970 [MWSYM]): 230-234.

Relaxation oscillations in bulk GaAs diodes in high impedance circuits have been analysed by a computer simulation by B. I. Jeppsson, and by W. Camp. At frequencies lower than the transit time frequency they have been observed in lumped circuits by Lanza and Esposito. In this paper we report time domain observation of LSA-relaxation oscillations in distributed circuits which tune over a wide range and have high peak powers as predicted in this mode of oscillation.

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Pin Diode Single-Sideband Modulator

R.V. Garver. "Pin Diode Single-Sideband Modulator." 1970 G-MTT International Microwave Symposium Digest of Technical Papers 70.1 (1970 [MWSYM]): 235-238.

A reflection-type single-sideband modulator is described that uses two PIN diodes separated by lambda/8. The modulator can give satisfactory suppression of undesired sidebands in a noncritical circuit, and computer simulations indicate that 20-dB suppression of the unwanted sidebands can be obtained over an octave bandwidth. It can provide even wider bandwidths when conventional C-section differential phase shifters are used.

Abstracts

Session WAM-II -- Guided Waves and Stripline

"Session WAM-II -- Guided Waves and Stripline." 1970 G-MTT International Microwave Symposium Digest of Technical Papers 70.1 (1970 [MWSYM]): 239-239.

Abstracts

General Constraints Upon Inhomogeneous Guided Wave Structures

J.D. Rhodes. "General Constraints Upon Inhomogeneous Guided Wave Structures." 1970 G-MTT International Microwave Symposium Digest of Technical Papers 70.1 (1970 [MWSYM]): 240-241.

During the last decade a large variety of inhomogeneous guided wave structures have been analysed in order to enable them to be used as microwave components. Circular or rectangular waveguides inhomogeneously loaded with dielectrics, ferrites or plasmas together with the conventional microstrip structures are probably the most common devices which have been analysed. However, few significant results have been obtained relating to the fundamental restrictions upon the behaviour of these classes of structures.

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Abstracts

Possible New Applications of Periodic Linear Arrays

L.-C. Shen. "Possible New Applications of Periodic Linear Arrays." 1970 G-MTT International Microwave Symposium Digest of Technical Papers 70.1 (1970 [MWSYM]): 242-244.

When the physical dimensions are adjusted properly, the periodic linear arrays, commonly known as Yagi-Uda arrays, may possibly be used as open waveguides or directional antennas operating at two or more widely separated frequency bands. Other applications include open low-pass or band-pass filters and open resonators.

Abstracts

Launching of the HE/sub 11/ Surface Wave Mode by an Electric Dipole Imbedded in a Dielectric Rod

G.L. Yip and T. Au-Yeung. "Launching of the HE/sub 11/ Surface Wave Mode by an Electric Dipole Imbedded in a Dielectric Rod." 1970 G-MTT International Microwave Symposium Digest of Technical Papers 70.1 (1970 [MWSYM]): 245-248.

Recently, there is much renewed interest in dielectric surface waveguides in view of their potential application in communications at the millimetric and optical frequencies. Many of the theoretical and practical problems involved were discussed in an informative survey by Kao. Among them, the excitation of surface waves on these waveguiding structures is, evidently, of much importance. One of the simplest structures, which is, nevertheless, of great practical utility, is the circular dielectric rod. The excitation of circularly symmetric surface waves on a dielectric rod by an elementary source, for example, a nagnetic current ring, has been investigated previously. However, a similar treatment for the HE/sub 11/ dipole mode is not available. The excitation of the HE/sub 11/ mode is of great practical importance, since it is the dominant mode and the easiest one to excite in a pure form if a single-mode operation is desired. Consequently, the HE/sub 11/ mode has been widely used. Snyder used an asymptotic approach in dealing with the excitation of modes on a semi-infinite dielectric rod, since the exact Green's functions for the fields were not known except for the circularly symmetric modes (TM/sub Om/ or TE/sub Om/). It is the purpose of the present paper to present a theoretical study of the problem of exciting the HE/sub 11/ mode.

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A Dual-Channel Rotary Joint for High Average Power Operation (1970 [MWSYM])

O.M. Woodward. "A Dual-Channel Rotary Joint for High Average Power Operation (1970 [MWSYM])." 1970 G-MTT International Microwave Symposium Digest of Technical Papers 70.1 (1970 [MWSYM]): 249-251.

Recently an X-band, dual-channel rotary joint was needed for the airborne terminal of a satellite communication link. Low losses were necessary in the high average power transmit channel (l2.5 KW, CW) to avoid excessive temperature rise, and in the receive channel to reduce the noise temperature of the system. Other important considerations were: no liquid or forced-air cooling; restricted size limitations; low cross-coupling between channels. A new type of rotary joint combining the TM/sub 01/ mode and the circularly-polarized TE/sub 11/ mode in circular waveguide was developed which satisfied the electrical, thermal, and size requirements of the system.

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Phase Stable Ridged Waveguide

E. Kramer. "Phase Stable Ridged Waveguide." 1970 G-MTT International Microwave Symposium Digest of Technical Papers 70.1 (1970 [MWSYM]): 252-256.

A method for designing a ridged waveguide transmission line so that its phase shift will be insensitive to temperature changes has been devised. Design equations and curves for choosing the ridge dimensions are presented, as well as curves of the guide attenuation and the compensation bandwidth. Experimental verification of the compensation effect by means of a resonant ridged waveguide cavity is shown.

Abstracts

Capacitance Matrix Data for Single, Double, and Triple Microstrip

A. Farrar and A.T. Adams. "Capacitance Matrix Data for Single, Double, and Triple Microstrip." 1970 G-MTT International Microwave Symposium Digest of Technical Papers 70.1 (1970 [MWSYM]): 257-261.

Basic capacitance matrix data have been computed for single, double and triple microstrip, using the method of moments. This basic design data has been computed for a wide variety of physical configurations and dielectric constants. Typical charge distributions have also been obtained. The method is applicable to a number of microstrip problems.

Abstracts

Transient Analysis of Lossless Coupled Transmission Lines in a Non-Homogeneous Dielectric Medium (1970 [MWSYM])

F.Y. Chang. "Transient Analysis of Lossless Coupled Transmission Lines in a Non-Homogeneous Dielectric Medium (1970 [MWSYM])." 1970 G-MTT International Microwave Symposium Digest of Technical Papers 70.1 (1970 [MWSYM]): 262-267.

This paper presents an effective method for computing the transient response of an n-conductor, coupled transmission-line system, which is characterized by multiple propagation modes of unequal phase velocities. To derive the computational algorithm, an equivalent circuit consisting of n decoupled transmission lines in conjunction with two congruence transformers was constructed and converted into two disjointed resistive n-ports. It is shown that the electrical behavior of the coupled transmission lines can be completely described by the static capacitance matrices of the conductor system. The experimental result obtained on a three-conductor, microstrip printed circuit was found to be in excellent agreement with the computed result.

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A New Method for the Analysis of the Dispersion Characteristics of Microstrip Lines

R. Mittra and T. Itoh. "A New Method for the Analysis of the Dispersion Characteristics of Microstrip Lines." 1970 G-MTT International Microwave Symposium Digest of Technical Papers 70.1 (1970 [MWSYM]): 268-272.

The dispersion characteristics of shielded microstrip lines are derived using a new method that yields highly accurate results from a 2 x 2 determinantal equation. Aside from numerical efficiency, the simple form of the equation allows one to easily locate the presence of higher order modes that have not been discussed elsewhere.

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Application of Ferrite to Electromagnetic Wave Absorber and its Characteristics (1970 [MWSYM])

Y. Naito and K. Suetake. "Application of Ferrite to Electromagnetic Wave Absorber and its Characteristics (1970 [MWSYM])." 1970 G-MTT International Microwave Symposium Digest of Technical Papers 70.1 (1970 [MWSYM]): 273-277.

This paper is concerned with an electromagnetic wave absorber utilizing ferrite or rubber ferrite composed of ferrite powder and rubber.

Abstracts

Session WPM-I -- Avalanche Diodes

"Session WPM-I -- Avalanche Diodes." 1970 G-MTT International Microwave Symposium Digest of Technical Papers 70.1 (1970 [MWSYM]): 278-278.

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GaAs IMPATT Diodes, Oscillators and Amplifiers

L.D. Armstrong. "GaAs IMPATT Diodes, Oscillators and Amplifiers." 1970 G-MTT International Microwave Symposium Digest of Technical Papers 70.1 (1970 [MWSYM]): 279-283.

This paper reviews the history and the state of the art of gallium arsenide impact avalanche transit time (IMPATT) diodes.

Abstracts

A One Watt CW, 20% Efficient X-Band Avalanche Diode Amplifier

D.M. Snider. "A One Watt CW, 20% Efficient X-Band Avalanche Diode Amplifier." 1970 G-MTT International Microwave Symposium Digest of Technical Papers 70.1 (1970 [MWSYM]): 285-288.

Efficient solid state X- band power generation can be accomplished by utilizing the negative impedance characteristics of avalanche diodes in reflection amplifiers. Breadboard 7 GC circuits have been constructed which exhibit low level gains of 13 db with 500 mc of bandwidth. Power outputs of 1 w cw, with 5 db of gain and 20% conversion efficiency have been realized in the same circuit.

Abstracts

RF Current and Voltage Waveform Measurement of an Oscillating Avalanche Diode

W.T. Chen and P. Scifo. "RF Current and Voltage Waveform Measurement of an Oscillating Avalanche Diode." 1970 G-MTT International Microwave Symposium Digest of Technical Papers 70.1 (1970 [MWSYM]): 289-290.

A method of measuring the rf impedance of an oscillating avalanche diode is described, and a technique for comparing calculated and measured rf impedance values for a variety of diffused Ge diode structures is considered. The value of this measurement method rests with its ability to provide values of the diode rf impedances under both large-signal and small-signal conditions for CW and pulsed operation in either the single-frequency or multifrequency mode of oscillation. The totality of these characteristics clearly delineates the uniqueness of this technique compared with conventional slotted-line measurements.

Abstracts

High Efficiency Solid State Microwave Amplifier Using TRAPATT Diodes

R.J. Hess and D.A. Floyd. "High Efficiency Solid State Microwave Amplifier Using TRAPATT Diodes." 1970 G-MTT International Microwave Symposium Digest of Technical Papers 70.1 (1970 [MWSYM]): 291-294.

Silicon IMPATT diodes have been used in a reflectance amplifier circuit to achieve a DC to RF conversion efficiency of 50 percent at S-band with 8 to 10 dB gain and 10 watts peak output. The RF circuit used was a four slug coaxial structure similar to that used by others in the production of high efficiency oscillations. A pulse width of one microsecond at a repetition rate of 5 KHz was used. The circuit configuration of the reflectance amplifier is shown in Figure 1.

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Performance of Multiple-Epitaxial Avalanche Diodes at X and Ku Bands

M.M. Blouke, D.D. Khandelwal, N.J. Tolar and H.M. Leedy. "Performance of Multiple-Epitaxial Avalanche Diodes at X and Ku Bands." 1970 G-MTT International Microwave Symposium Digest of Technical Papers 70.1 (1970 [MWSYM]): 295-299.

Two types of avalanche diodes are presently being used for microwave generation and amplification, the Read diodes, which have either n+-p-i-p+ or p+-n-i-n+ structure, and IMPATT and high-efficiency diodes which are simple p-n junctions usually with p+-n-n+ or n+-p-p+ structure. These devices are conventionally fabricated by diffusion techniques with the first layer epitaxially deposited on the substrate. Two other fabrication techniques which promise better device characteristics for junction devices are the ion-implantation and multiple-epitaxial techniques. This paper describes the fabrication, characteristics and performance of both Read and IMPATT diodes fabricated by the multiple-epitaxial technique.

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Abstracts

A Circuit Design for mm-Wave IMPATT Oscillators

N.D. Kenyon. "A Circuit Design for mm-Wave IMPATT Oscillators." 1970 G-MTT International Microwave Symposium Digest of Technical Papers 70.1 (1970 [MWSYM]): 300-303.

It is often required that a microwave source be of high power and fixed frequency and at the same time give low noise and be highly stable. Conventional coaxial circuits are somewhat impractical at millimetre wavelengths. The "hat" has been used with some success but its tuning characteristics are not readily understood, and so it is difficult to design for specific applications. A new coax-waveguide configuration has evolved which, it is believed, satisfies these requirements rather well in the 3-7 mm band, and it has accordingly been adopted for the power source of a path-length modulation transmitter. Results obtained have shown powers of 200 mw at 5% efficiency, temperature sensitivity as low as 300 kHz/ °C, and external Q factor around 200.

Abstracts

A New Microstrip Isolator and its Application to Distributed Diode Amplification

M.E. Hines. "A New Microstrip Isolator and its Application to Distributed Diode Amplification." 1970 G-MTT International Microwave Symposium Digest of Technical Papers 70.1 (1970 [MWSYM]): 304-307.

A new form of microstrip isolator is described here which was discovered during our search for an improved technique to obtain stable amplification with negative-resistance diodes distributed along a transmission line. We also report its successful application to that problem. This device uses a principle of nonreciprocal wave propagation which is also suitable for circulators. It may find other applications.

Abstracts

Session WPM-II -- Microwave Acoustics I

"Session WPM-II -- Microwave Acoustics I." 1970 G-MTT International Microwave Symposium Digest of Technical Papers 70.1 (1970 [MWSYM]): 308-308.

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Microwave Surface Wave Delay Lines as Practical Signal Processing Components

D.B. Armstrong and H. Skeie. "Microwave Surface Wave Delay Lines as Practical Signal Processing Components." 1970 G-MTT International Microwave Symposium Digest of Technical Papers 70.1 (1970 [MWSYM]): 309-310.

This paper will describe a family of Surface Wave accoustic delay lines in the 100 MHz to 1100 MHz frequency range which offer a practical way of satisfying many system delay line requirements more easily than with conventional bulk type delay lines. Microwave surface wave delay lines are made by evaporating metallic thin film interdigital transducers on a polished surface of a piezoelectric single crystal material such as lithium niobate. The transducer, whose impedance is determined by the coupling constant of the piezoelectric substrate and the geometry of the transducer electrodes, is matched to system impedances with relatively simple matching circuitry. The transducers are composed of a properly interconnected sequence of parallel lines which may be .85 - 6 microns wide, depending upon the frequency range. In contrast, microwave bulk wave transducers are made by either depositing an oriented piezoelectric thin film on the polished end of a single crystal rod, or by diffusing an insulated layer into the polished end of a relatively high conductivity piezoelectric semiconductor.

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Abstracts

L-Band Acoustic Surface-Wave Tapped Delay Line

H.M. Gerard, R.D. Weglein and E.D. Wolf. "L-Band Acoustic Surface-Wave Tapped Delay Line." 1970 G-MTT International Microwave Symposium Digest of Technical Papers 70.1 (1970 [MWSYM]): 311-313.

Microwave delay lines are of considerable interest because of the large time-bandwidth products that can be realized. Recently it has become possible to extend acoustic surface-wave technology into the microwave frequency range using the sub-micron capability of the scanning electron microscope. This paper reports the design and fabrication of a broadband multi-tapped delay line, centered at L-Band. Emphasis is placed on the microwave characterization of the low-frequency transducer circuit model, performance as strong and weak wideband taps, analysis of transducer and propagation is unique to loss contributions, as well as the fabrication technology which the realization of long, low-loss microwave delay lines.

Abstracts

The Effect of Beam Steering on the Design of Microwave Acoustic Surface Wave Devices

A.J. Slobodnik, Jr. and E.D. Conway. "The Effect of Beam Steering on the Design of Microwave Acoustic Surface Wave Devices." 1970 G-MTT International Microwave Symposium Digest of Technical Papers 70.1 (1970 [MWSYM]): 314-318.

The effect of beam steering on the design of microwave acoustic surface wave devices is investigated both theoretically and experimentally. Transducer, pure mode axis misalignment and misalignment of the propagation-plane perpendicular can both add significantly to delay line insertion loss. Beam steering losses are particularly high on Y-cut, Z-propagating LiNbO/sub 3/.

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Side Lobe Suppression in Surface Wave Acoustic Dispersive Delay Lines

W.L. Bongianni and J.H. Dickerman. "Side Lobe Suppression in Surface Wave Acoustic Dispersive Delay Lines." 1970 G-MTT International Microwave Symposium Digest of Technical Papers 70.1 (1970 [MWSYM]): 319-323.

Frequency coding of acoustic waves through the use of multi-element arrays has provided a unique solution to radar systerns requiring pulse compression. The recent advance in efficient coupling to surface acoustic waves on single crystal piezoelectric materials has resulted in the simplification in design of these devices. This simplification occurs because the transducer is made up of a two dimensional conducting metal film array which is produced by the standard photo-etch technique used in microcircuits. This paper discusses the control of phase and amplitude variations in a dispersive delay line using such an array and the resultant side lobe suppression achieved.

Abstracts

Session WPM-III -- Late News Items

"Session WPM-III -- Late News Items." 1970 G-MTT International Microwave Symposium Digest of Technical Papers 70.1 (1970 [MWSYM]): 323-323.

Abstracts

Session THAM-I -- Ferrite and Diode Phase Shifters

"Session THAM-I -- Ferrite and Diode Phase Shifters." 1970 G-MTT International Microwave Symposium Digest of Technical Papers 70.1 (1970 [MWSYM]): 324-324.

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Survey of Ferrimagnetic Materials - State of the Art

G.R. Harrison. "Survey of Ferrimagnetic Materials - State of the Art." 1970 G-MTT International Microwave Symposium Digest of Technical Papers 70.1 (1970 [MWSYM]): 325-326.

Magnetic ceramics of the ferrimagnetic structure are widely used in the microwave field. Many types are used so little attempt will be made here to cover all aspects of microwave ferrimagnetic ceramic materials. Three basic types or classes of magnetic crystal structures have found wide application in microwave components. These three classes of ferrimagnetic oxides are ferrites (spinels), garnets, and hexagonal materials. Each of these types contains families of completely different compositions, all of which possess their unique properties and characteristics applicable to microwave uses.

Abstracts

The Use of Manganese-Doped Iron Garnets and High Dielectric Constant Loading for Microwave Latching Ferrite Phasers

W.J. Ince, D.H. Temme, F.G. Willwerth and R.L. Huntt. "The Use of Manganese-Doped Iron Garnets and High Dielectric Constant Loading for Microwave Latching Ferrite Phasers." 1970 G-MTT International Microwave Symposium Digest of Technical Papers 70.1 (1970 [MWSYM]): 327-331.

The characteristics of ferrite materials desired for microwave devices with the material operated in the remanent state have been reviewed by Ince and Temme. The major deficiencies in the material for such applications have been the sensitivities of the remanent magnetization to both temperature and stress. Of the two most commonly used material systems, Mg-Mn ferrites and yttritum-iron garnets, the temperature sensitivity of the remanent magnetization of the garnet is less severe, particularly at low magnetization values. However, the stress sensitivity of the garnet is significantly greater than that of the ferrites and consequently, presents a serious problem for latching devices. Following earlier attempts to reduce the stress sensitivity through rare earth additions, which proved lossy, Dionne, et al. have shown that a small manganese addition to yttrium-iron garnet is effective for the reduction of magnetostriction. They have presented data suggesting that the microwave characteristics would also be satisfactory.

Abstracts

Ferrite Microstrip Phase Shifters-Theory and Experiment

G.J. Buck. "Ferrite Microstrip Phase Shifters-Theory and Experiment." 1970 G-MTT International Microwave Symposium Digest of Technical Papers 70.1 (1970 [MWSYM]): 332-336.

Past investigations of reciprocal, ferrite microstrip phase shifters have been concentrated on the effects of longitudinal magnetization (parallel to the microstrip) on the phase-shifting properties of linear sections of microstrip. The effect of a transverse magnetization in the plane of the substrate on the phase velocity of the propagating fields has been assumed to be nil. As shown in Figures 1 and 2, the phase shift induced by transverse magnetization has both a reciprocal and a non-reciprocal component and the composite phase shift induced by transverse magnetization is in the direction opposite to the phase shift generated by the longitudinal magnetization. Some non-reciprocal phase shift has been previously reported for widely spaced meander lines, but the effect was attributed to coupling between the lines. The presence of the non-reciprocal phase shift in a single linear section of microstrip is evidence of the fact that the propagating microstrip mode is not purely TEM in nature. This TEM approximation is generally made, although it has long been known that the wave is not pure.

Abstracts

A Dual-Mode Latching, Reciprocal Ferrite Phase Shifter (1970 [MWSYM])

C.R. Boyd, Jr.. "A Dual-Mode Latching, Reciprocal Ferrite Phase Shifter (1970 [MWSYM])." 1970 G-MTT International Microwave Symposium Digest of Technical Papers 70.1 (1970 [MWSYM]): 337-340.

An attractive method for producing reciprocal phase shift is to use a pair of identical nonreciprocal phase shifters with circulators at input and output, as shown in Figure 1. In this scheme, signals passing from left to right are sent through the lower phase shifter, while signals passing from right to left are sent through the upper phase shifter. By switching the phase shifters in a complementary manner, equal variable insertion phases can be provided for either direction of propagation. This approach to achieving reciprocal phase shift yields the desirable bandwidth, figure of merit, and temperature stability advantages of nonreciprocal phase shifters, except that it is more complicated and has the additional losses of the input and output circulators. However, the added complexity can be significantly reduced by employing a dual-mode transmission line in which the two nonreciprocal phase shifters occupy the same physical space. It is the purpose of this paper to describe the principle of operation, physical realization, and performance parameters for a reciprocal phase shifter of this latter type.

Abstracts

An X-Band Reciprocal Latching Faraday Rotator Phase Shifter

R.G. Roberts. "An X-Band Reciprocal Latching Faraday Rotator Phase Shifter." 1970 G-MTT International Microwave Symposium Digest of Technical Papers 70.1 (1970 [MWSYM]): 341-345.

Industry has given considerable attention to the development of low-cost phase shifters to be used as beam steering elements in phased array radars. Latching reciprocal ferrite phase shifters have received special attention because of the following considerations: (1) they can handle relatively high peak and average power levels, (2) they require no bias to maintain a phase setting, and (3) their reciprocal nature allows transmitting and receiving functions to occur without resetting the array. This paper presents a technique for obtaining a low loss X-band reciprocal latching ferrite phase shifter. The phase shifter is described by first considering the propagation constant of the circularly-polarized phase shift section and then discussing the nonreciprocal circular polarizers which are necessary to obtain reciprocal phase shift. The theoretical and experimental results of the phase shifter are then presented.

Abstracts

An S-Band, Dual Mode Reciprocal Ferrite Phaser for Use at High Power Levels

C.R. Boyd, Jr., L.R. Whicker and R.W. Jansen. "An S-Band, Dual Mode Reciprocal Ferrite Phaser for Use at High Power Levels." 1970 G-MTT International Microwave Symposium Digest of Technical Papers 70.1 (1970 [MWSYM]): 346-350.

This paper describes a new dual mode reciprocal phaser which operates at peak power levels of 100 kW and average power levels of 1500 watts over a -65°C to +85°C ambient temperature range. The device operates over a 370 frequency band centered at mid S-band. The total phase dispersion for the device is <5° for 200° differential phase shift. Details of the thermal design and ferrimagnetic materials selection are presented. Experimental data are given which indicates that the total insertion phase of the device varies less than 10° when incident average power is varied between 100 and 1100 watts. Little, if any change in differential phase shift is observed over this power range. Other similar phase shifters which provide up to 1000° differential phase shift at lower peak power levels are discussed.

Abstracts

A 3-KW Microstrip and Waveguide Diode Phase Shifter at X-Band

C.S. Ward. "A 3-KW Microstrip and Waveguide Diode Phase Shifter at X-Band." 1970 G-MTT International Microwave Symposium Digest of Technical Papers 70.1 (1970 [MWSYM]): 351-354.

The evolution of airborne phased arrays has created a need for small, lightweight phase shift elements, capable of high switching speeds and offering the prospect of quantity production at moderate cost. Microstrip diode phase shifters have been developed to meet these needs with peak power handling capabilities up to a hundred watts. This paper describes a novel extension of the use of these circuits to kilowatt power levels.

Abstracts

A High Power U. H. F. Diode Phase-Shifter

B.W. Leake. "A High Power U. H. F. Diode Phase-Shifter." 1970 G-MTT International Microwave Symposium Digest of Technical Papers 70.1 (1970 [MWSYM]): 355-357.

The electronically-scanned antenna, for which this phase-shifter was designed, requires the ability to switch the sense of circular polarization radiated or received by each antenna element. This necessary feature, together with the ability to control each antenna element phase in steps of 45-degrees, is provided by one microwave assembly, shown in Figure 1.

Abstracts

Session THAM-II -- Microwave Acoustics II

"Session THAM-II -- Microwave Acoustics II." 1970 G-MTT International Microwave Symposium Digest of Technical Papers 70.1 (1970 [MWSYM]): 358-358.

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Microwave Network Methods Applied to Acoustic Surface Waves

A.A. Oliner, R.C.M. Li and H.L. Bertoni. "Microwave Network Methods Applied to Acoustic Surface Waves." 1970 G-MTT International Microwave Symposium Digest of Technical Papers 70.1 (1970 [MWSYM]): 359-364.

One of the exciting new possibilities in the microwave field today is that of true microminiaturization with acoustic surface wave circuitry. Two of the possible acoustic surface waveguides which have been proposed are shown in Fig. 1. The behavior of these waveguides and of the circuits which could utilize them are not well understood, however, because of the complexity associated with boundary value problems involving acoustic waves in solids.

Abstracts

Theory of Rayleigh Wave Coupling Between Two Substrates by Means of a Solid Layer

K.H. Yen and R.C.M. Li. "Theory of Rayleigh Wave Coupling Between Two Substrates by Means of a Solid Layer." 1970 G-MTT International Microwave Symposium Digest of Technical Papers 70.1 (1970 [MWSYM]): 365-369.

When a Rayleigh wave is generated on a piezoelectric substrate, coupling to the Rayleigh wave on an adjacent piezoelectric substrate can be effected via the evanescent electric field in the air gap when the two substrates are brought close together. If the adjacent substrate is not piezoelectric, however, this method is no longer feasible and an alternative scheme must be employed. Such a scheme has recently been proposed and experimentally demonstrated. The coupling under these conditions is achieved by inserting a layer of fluid or solid between the two substrates, and energy is transferred via the mechanical rather than electric field.

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Abstracts

Distributed Components in Microwave Elastic Surface Wave Circuits

R.M. Knox and D.B. Owen. "Distributed Components in Microwave Elastic Surface Wave Circuits." 1970 G-MTT International Microwave Symposium Digest of Technical Papers 70.1 (1970 [MWSYM]): 370-374.

Research in the past several years on bulk acoustic devices, notably on delay lines, is now broadening to include a much larger family of devices because of recent developments in surface wave acoustics. Publications by White and Tiersten have shown that the elastic surface wave (Rayleigh wave) can be guided by a superficial layer which is about one wavelength thick. Tiersten provided a theoretical analysis for two types of guides, a strip guide in which a narrow film is deposited in the desired direction of propagation and a slot guide in which the film is deposited everywhere except in the desired direction of propagation. Tiersten's theoretical dispersion curves are presented along with a description of the useful single mode region which establishes a bandwidth limitation much as in conventional waveguide.

Abstracts

Acoustic Surface Wave Directional Couplers

L.R. Adkins and A.J. Hughes. "Acoustic Surface Wave Directional Couplers." 1970 G-MTT International Microwave Symposium Digest of Technical Papers 70.1 (1970 [MWSYM]): 375-379.

A theoretical and experimental investigation leading to the design and fabrication of surface wave directional couplers is discussed. A simple theoretical model for surface acoustic waveguides developed by Adkins and Hughes serves as the foundation for the present investigation. In this model guidance is achieved by thin gold strips deposited on fused quartz. This single guide model was then extended to the double guide structure which serves as a basis for coupled mode devices. A preliminary account of this work has been previously reported. Calculated coupling lengths, decay lengths, and modal amplitude ratios were found to be in good agreement with experiment. The double guide model was then employed for the design and fabrication of directional coupler devices. A brief account of this work is reported in Ref. 3. The general agreement between theory and experiment indicates that the model constitutes the basic foundation for design of practical coupled mode devices.

Abstracts

Optical Studies of Surface Wave Refractive and Reflective Device Structures

M.E. Pedinoff and M. Waldner. "Optical Studies of Surface Wave Refractive and Reflective Device Structures." 1970 G-MTT International Microwave Symposium Digest of Technical Papers 70.1 (1970 [MWSYM]): 380-384.

In this paper we report the results of an investigation of the propagation of ultrasonic surface waves In "Y"-cut lithium niobate crystals which have geometrically shaped thin gold film structures similar to optical prisms placed in the propagation path of the sound wave. The method of investigation using a pulsed argon laser is a variation of the CW laser optical spatial filter imaging technique recently developed here for optically recording the propagation paths of surface ultrasonic waves in piezoelectric and non-piezoelectric media.

Abstracts

Surface Wave Grating Reflectors and Resonators

E.A. Ash. "Surface Wave Grating Reflectors and Resonators." 1970 G-MTT International Microwave Symposium Digest of Technical Papers 70.1 (1970 [MWSYM]): 385-386.

The realization of complex microsound circuits would be greatly facilitated if one were able, efficiently to reflect the surface waves. For example, such reflectors are required for making a "short-circuited" stub, or for a low mode-order resonator. It is known that the interdigital transducer can reflect a surface wave, with rather low losses; however, this approach involves the use of an external inductive tuning circuit, which must be attached to the transducer in order to resonate its self-capacitance. It is therefore a method which cannot be used in those situations where the primary objective is the achievement of very large component densities.

Abstracts

Session THPM -- Ferrite Components - General

"Session THPM -- Ferrite Components - General." 1970 G-MTT International Microwave Symposium Digest of Technical Papers 70.1 (1970 [MWSYM]): 387-387.

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The Compact Turnstile Circulator (1970 [MWSYM])

B. Owen and C.E. Barnes. "The Compact Turnstile Circulator (1970 [MWSYM])." 1970 G-MTT International Microwave Symposium Digest of Technical Papers 70.1 (1970 [MWSYM]): 388-392.

Many broadband 3-port waveguide circulators have dielectric spacers between the ferrite and the broad walls of the waveguide junction, as shown in Figure 1. In terms of the two-resonant mode theory employed to explain the Y junction circulator, these spacers were regarded as impedance adjustments which were needed to produce broadband circulation.

Abstracts

A Compact Thin Film Lumped Element Circulator Using a Capacitor, Common to All Three Arms, for Broadbanding or Switching

R.H. Knerr. "A Compact Thin Film Lumped Element Circulator Using a Capacitor, Common to All Three Arms, for Broadbanding or Switching." 1970 G-MTT International Microwave Symposium Digest of Technical Papers 70.1 (1970 [MWSYM]): 393-396.

A thin film lumped element circulator using only cross-over capacitances and a single capacitor comon to all three ports, the equivalent circuit of which is shown in Figure 1a, has yielded a 20 dB bandwidth > 30%.

Identification of Spurious Responses in Waveguide Circulators (Abstract)

J.B. Castillo and L.E. Davis. "Identification of Spurious Responses in Waveguide Circulators (Abstract)." 1970 G-MTT International Microwave Symposium Digest of Technical Papers 70.1 (1970 [MWSYM]): 397-397.

Two classes of spurious response in waveguide circulators are described. Examples of these responses from previous work are shown. One class of spurious response is a well known "spiking" phenomenon which has not previously been discussed explicitly. This type of response is identified as one or more resonant modes of the open post resonator formed by the cylindrical ferrite/dielectric configuration between the conducting top and bottom walls of the circulator cavity. The second class of spurious response is related to the h-port circulator problem which gives good agreement between theory and experiment for unmagnetized ferrite, and good agreement near the maximum-isolation frequency for magnetized ferrite, but gives generally poor results outside this frequency range. Directions of continuing work are indicated.

Abstracts

A Short-Slot Waveguide Latching Ferrite Switch (1970 [MWSYM])

S. Nakahara and H. Kurebayashi. "A Short-Slot Waveguide Latching Ferrite Switch (1970 [MWSYM])." 1970 G-MTT International Microwave Symposium Digest of Technical Papers 70.1 (1970 [MWSYM]): 398-403.

Recently many latching switches are investigated and reported on. The switch proposed here is a kind of circulators but a new one which has different structure from usual switches. This switch has relatively compact dimensions as a high power switch, and gives little variation of VSWR during switching, and makes it possible to divide out-put power between two ports at arbitrary rate. This paper describes the structure, the principle of operation, the numerical estimation of isolation characteristics and the experimental results of this switch.

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An Analysis of Nonreciprocal Microstrip

J.A. Weiss. "An Analysis of Nonreciprocal Microstrip." 1970 G-MTT International Microwave Symposium Digest of Technical Papers 70.1 (1970 [MWSYM]): 404-408.

Some progress has been reported in the development of nonreciprocal and magnetically variable devices in the microstrip transmission medium. Further investigation and analysis remain in order for optimum performance to be characterized theoretically and achieved in practice. The objectives are to achieve favorable performance in insertion loss and bandwidth of phase shifters and other components, an acceptable combination of microwave characteristics and switching properties in variable devices, and freedom from spurious interactions between these components and the circuits in which they are imbedded.

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Microwave Signal Processing by Amplified Ferrimagnetic Echo

R.M. Hill, D.E. Kaplan, G.F. Hermann and S.K. Ichiki. "Microwave Signal Processing by Amplified Ferrimagnetic Echo." 1970 G-MTT International Microwave Symposium Digest of Technical Papers 70.1 (1970 [MWSYM]): 409-413.

The recent discovery of amplified ferrimagnetic echoes (AFE) suggests that a number of microwave signal processing applications may be realized to advantage with this new technology. These include pulse amplification and delay, pulse compression, frequency multiplexing, and spectrum analysis. The results described below were obtained in YIG crystals at room temperature in the frequency range 8 - 12 GHz.

Abstracts

Bandpass and Bandsectioning Filters Using Epitaxial YIG Films

W.L. Bongianni and L. Young. "Bandpass and Bandsectioning Filters Using Epitaxial YIG Films." 1970 G-MTT International Microwave Symposium Digest of Technical Papers 70.1 (1970 [MWSYM]): 414-419.

The epitaxial growth of yttrium iron garnet (YIG) films on gallium garnet (GGG) has allowed the construction of microwave gadolinium devices compatible with current microwave integrated technology. This paper describes the construction and operation of a bandpass filter and a band-sectioning filterbank.

Abstracts

Committees (1970 [MWSYM])

"Committees (1970 [MWSYM])." 1970 G-MTT International Microwave Symposium Digest of Technical Papers 70.1 (1970 [MWSYM]): 420-422.

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Membership Application (1970 [MWSYM])

"Membership Application (1970 [MWSYM])." 1970 G-MTT International Microwave Symposium Digest of Technical Papers 70.1 (1970 [MWSYM]): 423-423.

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Index to Institutional Listings (1970 [MWSYM])

"Index to Institutional Listings (1970 [MWSYM])." 1970 G-MTT International Microwave Symposium Digest of Technical Papers 70.1 (1970 [MWSYM]): 424-425.

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