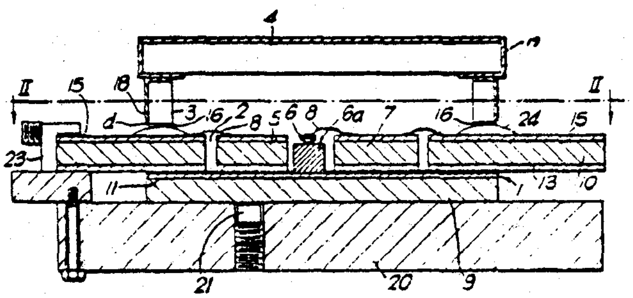
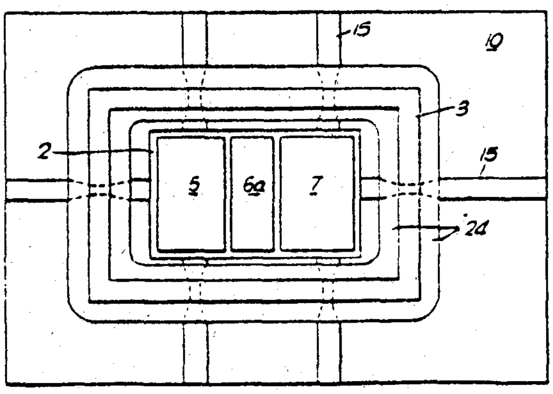
plate. The entire package may be fabricated using materials and techniques compatible with those used in fabricating MIC's, for example thick film.

12 Claims, 5 Drawing Figures





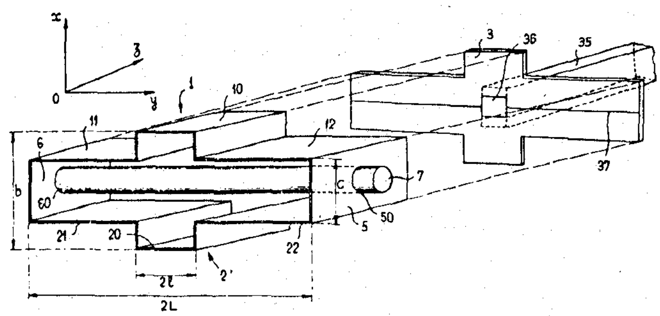
4,259,561 Mar. 31, 1981

Microwave Applicator

Inventors: Georges Roussy; André-Jean Berteaud; Jean-Marie Thiebaut.
Assignee: Agence Nationale de Valorisation de la Recherche (ANVAR).
Filed: May, 1, 1978.

Abstract—The invention provides a microwave feeder or applicator, that is to say a resonant chamber for coupling to a source of microwaves, arranged for the microwave treatment of a sample of material, comprising two main conductive walls extending parallel to a common axial direction and each having two projections and a central part joining the two projections, the projections of the two walls facing one another in pairs whereas the central parts of the two walls likewise face one another and define a region in which there is a local increase in the distance between the two main walls; a first conductive end wall forming a short-circuit and extending in a plane forming a cross-section of the main walls; a second conductive end wall forming a second short-circuit extending in a plane forming a cross-section of the main walls, and a coupling means for supplying microwave energy to the feeder, the dimensions of the cavity formed by the main end walls being arranged so that the cavity resonates almost exclusively in the TE_{11} mode, where the electric field is oriented along the cross-section of the main walls.

27 Claims, 12 Drawing Figures



Overseas Abstracts

Papers from Journals Published in Australia, India, and Japan

Compiled by Prof. E. Yamashita, University of Electro-Communications, Tokyo, Japan.

The periodicals investigated are: 1) Transactions of the Institute of Electronics and Communication Engineers of Japan (Trans. IECEJ), 2) Journal of the IECEJ, 3) Journals of the Institution of Engineers (JIE. (India)), Electronics and Telecommunication Engineering Division (Part ET), 4) Proceedings of the Institution of Radio and Electronics Engineers, (Proc. IREE (Australia)), and 5) Australian Telecommunication Research (ATR).

As for the Japanese papers in the Trans. IECEJ, which carry volume numbers J63B or J63C, single-page English summaries (1/4 page for Correspondences) will be found in the "Transactions of IECEJ, Section E" issued in the same month, where "E" denotes English. Papers carrying volume number E63 are papers written originally in English and will be found in Section E. Both the Section-J and Section-E issues are published from the IECEJ, Kikai-Shinko-Kaikan, 3-5-8 Minato-ku, Tokyo 105, Japan.

The full translations of some Japanese papers will appear in *Electronics and Communications in Japan*, published by Scripta Publishing Co., 7961 Eastern Avenue, Silver Spring, MD 20910.

Active Microwave Devices

1

An Equivalent Circuit Analysis of the Influence of Parasitic Inductances of Power Gain of a Microwave Static Induction Transistor (SIT), by Y. Kajiwara, M. Aiga, Y. Higaki, and M. Kato (Semiconductor Laboratory, Mitsubishi Electric Corp., Itami-shi, 664 Japan): *Trans. IECEJ*, vol. J63-C, no. 2, pp. 117–124, February 1980.

An equivalent circuit of the SIT is proposed, compared with that of the FET, and confirmed by experimental results. The influence of the source lead inductance on the power gain is analyzed to obtain higher power gain.

2

Effect of the Circuit of Second-Harmonic Frequency on IMPATT Oscillators, by Y. Shindo and S. Okamura (Faculty of Engineering, Tokyo Denki University, Tokyo, 101 Japan): *Trans. IECEJ*, vol. J63-B, no. 4, pp. 286–293, April 1980.

The properties of IMPATT oscillators in microwave and millimeter wave region are affected by the circuit admittance at harmonic frequencies. This paper discusses the influence of the second harmonic component on the behavior of the IMPATT diode.

3

Superconducting Cavity Stabilized Oscillators by Self-Injection Locking, by B. Komiyama and Y. Yasuda (Radio Research Laboratories, Ministry of Posts and Telecommunications, Koganei-shi, 184 Japan): *Trans. IECEJ*, vol. J63-B, no. 4, pp. 294–301, April 1980.

The theory of cavity stabilization of a microwave oscillator is reviewed and appropriate design equations for the above oscillators are given. The theory is confirmed with the data of Gunn oscillators stabilized by a superconducting cavity made of Nb.

4

Microwave Transmission-Type Dielectric Resonator Transistor Oscillator, by T. Hayasaka, S. Shinozaki, and K. Sakamoto (Nippon Electric Co., Ltd., Yokohama-shi, 226 Japan): *Trans. IECEJ*, vol. J63-B, no. 5, pp. 484–490, May 1980.

The characteristics of a transmission-type oscillator with a dielectric resonator is analyzed to know its output power, frequency stability, and tunable frequency range. Experimental results of a 6-GHz oscillator and a 12-GHz oscillator are described.

5

Effects of Harmonic Signal on Noise Characteristics of IMPATT Diode (Correspondence), by M. Fukushima (Computing Center, Hiroshima University, Hiroshima-shi, 730 Japan) and T. Kawano (Faculty of Engineering, Hiroshima University, Hiroshima-shi, 730 Japan): *Trans. IECEJ*, vol. J63-B, no. 5, pp. 530–531, May 1980.

The noise characteristics of an IMPATT diode oscillator under two-frequency operation are described. Theoretical results of the short-circuit noise-current spectrum are shown as a function of frequency and of the phase of the electric field at the second harmonic frequency.

6

Simultaneous Three Frequency Oscillation in Gunn Diodes (Correspondence), by Y. Iida and M. Morita (Faculty of Engineering, Kansai University, Suita-shi, 564 Japan): *Trans. IECEJ*, vol. J63-B, no. 5, pp. 536–538, May 1980.

Simultaneous three-frequency oscillation in a Gunn diode 9-GHz oscillator with a double waveguide-cavity was experimentally observed. An application of this phenomenon is discussed.

7

Optimum Phase Regeneration Conditions and Noise Reduction Characteristics of the Phase Regenerators by Use of a Parametrically Excited Nonlinear Capacitor, by H. Umeda (Faculty of Engineering, Fukui University, Fukui-shi, 910 Japan), M. Nakajima, and J. Ikenoue (Faculty of Engineering, Kyoto University, Kyoto-shi, 606 Japan): *Trans. IECEJ*, vol. J63-B, no. 9, pp. 831–836, September 1980.

The optimum phase conditions and the noise reduction factor of the phase regenerator are discussed comparing with experimental results at 4 GHz.

8

Analysis of Oscillation Characteristics and Design of a Plate-Type IMPATT Oscillator, by T. Chiang, I. Suemune, M. Fukushima, M. Yamanishi, and T. Kawano (Faculty of Engineering, Hiroshima University, Hiroshima-shi, 730 Japan): *Trans. IECEJ*, vol. J63-B, no. 12, pp. 1270–1276, December 1980.

The admittance of an IMPATT diode pellet estimated with a large-signal analysis and the equivalent circuit parameters of a diode package given by experiments are used to obtain oscillation characteristics. Results of experiments at 10 GHz are shown.

9

Bias-Current-Tuned IMPATT Oscillators for 100–200 GHz (Correspondence), by E. Hagihara, M. Akaike (Yokosuka Electrical Communication Laboratory, N.T.T., Yokosuka-shi, 238-03 Japan), and K. Yamamoto (Musashino Electrical Communication Laboratory, N.T.T., Musashino-shi, 180 Japan): *Trans. IECEJ*, vol. J63-B, no. 12, pp. 1324–1325, December 1980.

This paper described the results of an experimental investigation on the relationship between structural parameters and oscillation characteristics to make a broad-band tunable oscillator. The tuning bandwidth of 30 GHz at the 140-GHz and 200-GHz range was obtained.

Passive Microwave Devices

1

A Design of 6-Port Compensating Circuits for Circulators, by A. Ikeda, K. Araki (Faculty of Engineering, Tokyo Institute of Technology, Tokyo, 152 Japan), M. Iwakuni (Fujitsu Laboratories LTD., Kawasaki-shi, 211 Japan), and Y. Naito (Faculty of Engineering, Tokyo Institute of Technology, Tokyo, 152 Japan): *Trans. IECEJ*, vol. J63-B, no. 1, pp. 78–83, January 1980.

The synthesis of general 6-port compensating circuits is discussed and a simple design procedure with few susceptance elements is developed. Experimental results at 200 MHz confirmed the usefulness of the design method.

2

100-GHz Band Low-Loss Band-Splitting Diplexer Using Gaussian Beam, by R. Watanabe and N. Nakajima (Yokosuka Electrical Communication Laboratory, N.T.T., Yokosuka-shi, 238-03 Japan): *Trans. IECEJ*, vol. J63-B, no. 2, pp. 151–158, February 1980.

This paper describes the design method and experimental results of a novel quasi-optical band-splitting diplexer with Tchebycheff frequency response. The measured value of insertion loss is less than 1.0 dB in the low-frequency band (80.8~100.8 GHz) and less than 0.5 dB in the high-frequency band (100.8~120 GHz).

3

Multi-Branch Filter (Correspondence), by T. Itanami and N. Nakajima (Yokosuka Electrical Communication Laboratory, N.T.T., Yokosuka-shi, 238-03 Japan): *Trans. IECEJ*, vol. J63-B, no. 3, pp. 270–271, March 1980.

This paper describes the characteristics of a new filter composed of an input waveguide, three resonators, and three output waveguides, to multiplex three RF carriers all at once. Measured transmission characteristics at 18 to 19 GHz are also shown.

4

Fabrication and RF Surface Resistance of Superconducting Lead Cavity by a Press Forming Technique, by T. Momose, K. Akada, T. Yamashita, and Y. Onodera (Institute of Electrical Communication, Tohoku University, Sendai-shi, 980 Japan): *Trans. IECEJ*, vol. J63-B, no. 4, pp. 310–316, April 1980.

The extrapolated value of the RF residual surface resistance is 2.0×10^{-8} Ω which is the lowest one observed to date in both TM- and TE-mode lead-cavities operating at 10 GHz.

5

Constant-Resistance Phase Equalizers Using Directional Couplers, by K. Ohue (Yokosuka Electrical Communication Laboratory, N.T.T., Yokosuka-shi, 238-03 Japan): *Trans. IECEJ*, vol. J63-B, no. 5, pp. 460–467, May 1980.

This paper describes a design method of phase equalizers for the bit rate above 1 Gbit/s. The measured delay characteristics of an experimentally fabricated equalizer up to 2 GHz agree well with the theoretical values.

6

The Electromagnetic Absorbing Wall with Resistive Sheets of the Frequency Locus of Its Complex Reflection Coefficient Being Circular, by M. Takashima (Faculty of Engineering, Tokyo University of Agriculture and Technology, Koganei-shi, 184 Japan): *Trans. IECEJ*, vol. J63-B, no. 6, pp. 619–626, June 1980.

This paper describes an absorbing structure composed of parallel resistive sheets placed at intervals and a conductor plate. The input admittance locus of the structure is shown on the Smith's chart.

7

On the Applications of the Slot-Coupled Narrow Wall Directional Coupler (Correspondence), by T. Tanaka (Yokosuka Electrical Communication Laboratory, N.T.T., Yokosuka-shi, 238-03 Japan): *Trans. IECEJ*, vol. J63-B, no. 6, pp. 645–646, June 1980.

The principle of this coupler is based on the interference among the TE_{10}-, TE_{20}-, and TE_{30}-modes. The coupler can be used as a variable power divider or a compact 8×8 port directional coupler.

8

Quasi-Optical Elliptic Filter Using a 3 dB Hybrid, by N. Nakajima (Yokosuka Electrical Communication Laboratory, N.T.T., Yokosuka-shi, 238-03 Japan): *Trans. IECEJ*, vol. J63-B, no. 8, pp. 735–742, August 1980.

This filter is composed of a hybrid, made of a fused quartz disk and two coupled resonators, and has high return-loss in passbands and high through-loss in stopbands. Experimental results in the 100-GHz band are compared with theory.

9

A Design Method of Broad-Band Polarizer Using Metallic Posts, by O. Ishida, S. Kaniya, and F. Takeda (Mitsubishi Electrical Corp., Kamakura-shi, 247 Japan): *Trans. IECEJ*, vol. J63-B, no. 9, pp. 908–915, September 1980.

A broad-band polarizer using a circular waveguide loaded with metallic posts is described. An experimental polarizer with the axial ratio of 0.25 dB in 12.6-percent bandwidth was constructed with this design method.

10

The Filter Characteristics of a Periodically Corrugated Dielectric-Slab Waveguide in Millimeter-Wave Region—Comparison between Perturbation Theory and Experiment, by T. Ohira, M. Tsutsumi, and N. Kumagai (Faculty of Engineering, Osaka University, Suita-shi, 565 Japan): *Trans. IECEJ*, vol. J63-B, no. 9, pp. 947–948, September 1980.

A boundary perturbation procedure for calculating the propagation characteristics of the TM waves along a periodically corrugated slab is presented and confirmed with the results of an experiment at 45 GHz.

11

Detection with Net-Structure Arrays of Josephson Junctions, by N. Fujimaki, Y. Okabe (Faculty of Engineering, University of Tokyo, Tokyo, 113 Japan), and S. Okamura (Faculty of Engineering, Tokyo Denki University, Tokyo, 101 Japan): *Trans. IECEJ*, vol. J63-B, no. 11, pp. 1110–1116, November 1980.

A new method for fabricating the arrays of the point-contact Josephson junctions is described. The results of preliminary experiments at 4.2 K for the detection of 10-GHz radiation from a HCN laser are also shown.

12

The Characteristics of Self-Supported Diplexer (Correspondence), by K. Sha, T. Shoji, M. Suzuki, and Y. Kaneda (Faculty of Engineering, Yamagata University, Yamagata-shi, 992 Japan): *Trans. IECEJ*, vol. J63-B, no. 11, pp. 1148–1149, November 1980.

This paper describes the experimental characteristics of a quasi -optical self-support diplexer at 3–12 GHz, and gives empirical design expressions for the diplexer.

13

A New Variable Directional Coupler Using n-InSb Thin Films, by I. Tanaka, M. Isai, and M. Ohshita (College of Engineering, Shizuoka University, Hamamatsu-shi, 432 Japan): *Trans. IECEJ*, vol. J63-C, no. 11, pp. 759–765, November 1980.

This paper describes a variable-coupling directional coupler with the use of the magnetoresistance effect in InSb films under the magnetic field. Experimental results show the variation of the coupling from 19.3 dB to 42.4 dB at 33.8 GHz.

14

Rubber-Ferrite Electromagnetic Absorber with Wavy Structure for Outdoor Usage, by T. Kaino and N. Murata (Musashino Electrical Communication Laboratory, N.T.T., Musashino-shi, 180 Japan): *Trans. IECEJ*, vol. J63-B, no. 12, pp. 1193–1199, December 1980.

This paper describes an absorber structure made of rubber-ferrite and metal, and constructed as a wavy plate. The reflectivity reduction with the absorber at 4–6 GHz is more than 15 dB.

15

Design Fabrication and Testing of 3 dB Lange Coupler, by A. K. Sinha (Military College of Telecommunication Engineering, Mhow (MP), India) and M. Selot (Government Engineering College, Jabalpur, India): *JIE.* (India), pt. ET, vol. 61, no. ET2, pp. 60–62, December 1980.

An attempt is made to design, fabricate and test a Lange tight coupler so that the production of such couplers could be considered. The measured coupling at 2–4 GHz shows that the coupler is fairly broad band.

16

Fabrication and Analysis of Broad Band Microwave Absorbers, by R. C. Jain, D. Guha, and J. P. Gupta (University of Roorkee, Roorkee, India), *JIE.* (India): pt. ET, vol. 61, no. ET2, pp. 63–65, December 1980.

This work deals with the inhomogeneous layer absorbers and low-density absorbers. A theoretical model based on the typical variation of the permittivity profile along the absorbers is described and compared with experimental results in the *X*-band.

17

On the Physical Realisability of Stripline Bandstop Filters, by P. M. Gregory (Transmission Network Design Branch, Telecom Australia) and K. K. Pang (Department of Electrical Engineering, Monash University, Melbourne, Australia): *ATR*, vol. 13, no. 2, pp. 32–38, 1980.

A simple method of checking for the physical realizability is presented. A new construction geometry is introduced, eliminating the need for impedance transformers in some cases, and extending the realizable range of designs.

Transmission Lines and Waveguides

1

Finite-Element Analysis of Dielectric Image Lines by Discriminating the Field Strengths at Virtual Boundaries (Correspondence), by M. Ikeuchi, K. Inoue (Faculty of Science and Engineering, Ritsumeikan University, Kyoto-shi, 603 Japan), H. Sawami, and H. Niki (Faculty of Science, Okayama University of Science, Okayama-shi, 700 Japan): *Trans. IECEJ*, vol. J-63B, no. 1, pp. 87–89, January 1980.

This paper shows the finite-element analysis of rectangular dielectric image lines for millimeter-wave integrated circuits assuming virtual conductor boundaries. The validity of the analysis is discussed by comparing the errors of the computed wavenumber with the field strength at the boundaries.

2

Analysis of Tapered Optical Slab Waveguides with Hypothetical Boundaries, by S. Sawa, K. Ono (Faculty of Engineering, Ehime University, Matsuyama-shi, 790 Japan), H. Odaka (Yamasaki Kiko company, Fukuyama-shi, 720 Japan), and M. Sakuma (Nippon Electric Co., Ltd., Tokyo, 108 Japan): *Trans. IECEJ*, vol. J63-C, no. 2, pp. 104–111, February 1980.

The configuration of a tapered slab waveguide is approximated by a number of small steps, and electric walls surrounding the waveguide are assumed. Only a few of propagation modes are required to obtain radiation loss with high accuracy.

3

A Novel Energy Relation in Eigen Modes of Transmission Line and Its Application to the Derivation of Variational Expression for Propagation Constant (Letters), by K. Araki and Y. Naito (Faculty of Engineering, Tokyo Institute of Technology, Tokyo, 152 Japan): *Trans. IECEJ*, vol. E63, no. 2, pp. 116–117, February 1980.

A novel energy and power-flow relation for the eigen modes of a uniform transmission line is proposed and the variational expressions of propagation constant for two waveguide structures are systematically derived.

4

A Simplified Analysis of Ferrite-Strip, by K. Araki, S. Enjohji, and Y. Naito (Faculty of Engineering, Tokyo Institute Technology, Tokyo, 152 Japan): *Trans. IECEJ*, vol. J63-B, no. 3, pp. 211–217, March 1980.

The ferrite-strip has many features suitable for nonreciprocal circuits in millimeter and optical wavelength. This paper gives a simplified analytical treatment of the ferrite-strip by using an equivalent ferrite slab model and an effective permittivity.

5

Study of the Design of a Beam Wave Guide, by T. Ohmori (Faculty of Engineering, Niigata University, Niigata-shi, 950-21 Japan): *Trans. IECEJ*, vol. J63-B, no. 4, pp. 317–324, April 1980.

The electrical field distribution and the transmission loss of a beam waveguide are discussed to give a design method of the low-loss beam waveguide in special cases.

6

Microwave Network Analyses of Dielectric Waveguides for Millimeter Waves Made of Dielectric Strip and Planar Dielectric Layer, by M. Koshiba and M. Suzuki (Faculty of Engineering, Hokkaido University, Sapporo, 060 Japan): *Trans. IECEJ*, vol. E63, no. 5, pp. 344–350, May 1980.

The transverse resonance method is applied to the derivation of approximate dispersion relations of the dielectric waveguides. The dispersion characteristics estimated by this method well agree with the experimental data in other papers.

7

On the Waveguide for Magnetostatic Surface Wave (Correspondence), by H. Tanaka and H. Shimizu (Faculty of Engineering, Tohoku University, Sendai-shi, 980 Japan): *Trans. IECEJ*, vol. J63-B, no. 6, pp. 651–653, June 1980.

The ridge waveguide for magnetostatic surface waves is analyzed by a means of the microwave network method and some numerical results are shown.

8

Numerical Analysis of Two Parallel Thin-Film Waveguides, by K. Yasuura and H. Kubo (Faculty of Engineering, Kyushu University, Fukuoka-shi, 812 Japan): *Trans. IECEJ*, vol. J63-C, no. 6, pp. 337–344, June 1980.

Two parallel thin-film waveguides are numerically analyzed with the mode-matching method. The propagation constants of even modes and odd modes are precisely calculated to characterize the thin-film waveguide as a directional coupler.

9

Analysis of Anisotropic Dielectric Waveguides with Random Boundary Interface, by J. Yamakita and K. Rokushima (Faculty of Engineering, University of Osaka Prefecture, Sakai-shi, 591 Japan): *Trans. IECEJ*, vol. J63-C, no. 6, pp. 345–352, June 1980.

This paper describes an analytical method for treating the mode conversion and scattering loss due to the random fluctuation of boundary interface in an anisotropic dielectric waveguide. Random coupling between TE- and TM-modes is discussed by the use of the coupled power equations.

10

A Co-ordinate Transformation for the Numerical Analysis of Microstrip Transmission Lines, by E. H. Fooks and P. H. Ladbrooke (School of Electrical Engineering, University of New South Wales, Kensington, N.S.W. 2033 Australia): *Proc. IREE* (Australia), vol. 41, no. 2, pp. 74–78, June 1980.

This method is based on the finite difference solution for the potential distribution, with the coordinates being first transformed into a space where infinity is represented by a finite point. The capacitance is found for relatively coarse grids.

11

A Study of Transmission Characteristics of Superconducting Coaxial Lines, by H. Yoshikiyo (Musashino Electrical Communication Laboratory, N.T.T., Musashino-shi, 180 Japan): *Trans. IECEJ*, vol. J63-B, no. 7, pp. 715–722, July 1980.

This paper describes the attenuation versus frequency characteristics and the step-pulse response of miniature superconducting coaxial lines. The measured attenuation constant at 1 GHz and 4.2 K was 0.75 dB/km, and the rise time for a 1 km-coaxial line was 175 ps.

12

Microwave Leakage and Power-Handling Capability of Beam Waveguides (Correspondence), by T. Shiota, T. Yoneyama, and S. Nishida (Research Institute of Electrical Communication, Tohoku University, Sendai-shi, 980 Japan): *Trans. IECEJ*, vol. J63-B, no. 8, pp. 818–819, August 1980.

The power leakage formulas of beam waveguides consisting of lenses or reflectors with finite radii are presented in a simple, closed form.

13

Characteristics of Dielectric Rib Waveguide Analyzed by the Approximated Mode-Matching Method and Experiments in the Millimeter Wave Region, by M. Tsuji, H. Shigesawa, and K. Takiyama (Faculty of Engineering, Doshisha University, Kyoto-shi, 602 Japan): *Trans. IECEJ*, vol. J63-B, no. 9, pp. 884–891, September 1980.

The transmission characteristics of a dielectric rib waveguide are approximately analyzed by satisfying boundary conditions with the method of least squares. Experimental results at 50 GHz are also shown.

14

Dispersion Characteristics of Slot Line on a Sapphire Substrate (Correspondence), by Y. Hayashi (Faculty of Engineering, Kitami Institute of Technology, Kitami-shi, 090 Japan), T. Kitazawa, and M. Suzuki (Faculty of Engineering, Hokkaido University, Sapporo-shi, 060 Japan): *Trans. IECEJ*, vol. J63-B, no. 10, pp. 1013–1014, October 1980.

A theoretical method for the analysis of a slot line on a sapphire substrate is described. The propagation constants of the dominant mode and first-order mode are shown.

Microwave Field and Circuit Theory

1

Mutual Transformation for *S*-Parameters (Correspondence), by K. Nishio and H. Yabe (Junior Technical College of Electro-Communications, Chofu-si, 182 Japan): *Trans. IECEJ*, vol. J63-B, no. 5, pp. 533–535, May 1980.

This paper gives the mutual transformation of the scattering parameters for different terminal impedances. This transformation is easily carried out with the use of ideal transformers and the T-matrices.

2

Analysis of Discrete Wave System by Optical Ray Operators, by Y. Aoki (Faculty of Engineering, Hokkaido University, Sapporo-shi, 060 Japan): *Trans. IECEJ*, vol. J63-C, no. 7, pp. 430–437, July 1980.

An optical ray operator method is developed to describe wave propagation phenomena with discrete variables. Operators are introduced associated with the discrete states of position and spatial frequency.

3

Reflection of a Gaussian Beam at Oblique Incidence on a Stratified Dielectric Medium, by M. Tanaka, N. Saga, and O. Fukumitsu (Faculty of Engineering, Kyushu University, Fukuoka-shi, 812 Japan): *Trans. IECEJ*, vol. J63-B, no. 8, pp. 751–758, August 1980.

The medium is composed of N dielectric layers with different refractive index. The reflected field from the layers is expanded in a form of beam mode functions. The effect of the smallest spot size on the reflection characteristics is discussed.

4

Transient Analysis of Three-Dimensional Electromagnetic Fields by Nodal Equations, by N. Yoshida, I. Fukai, and J. Fukuoka (Faculty of Engineering, Hokkaido University, Sapporo-shi, 060 Japan): *Trans. IECEJ*, vol. J63-B, no. 9, pp. 876–883, September 1980.

This paper describes a new method for the numerical transient analysis of the electromagnetic field based on the correspondence between Maxwell's equations and the nodal equations for lattice network.

5

A Consideration of Time Domain Analysis of Distributed Constant Networks, by M. Suzuki, I. Sakagami, N. Miki, and N. Nagai (Research Institute of Applied Electricity, Hokkaido University, Sapporo-shi, 060 Japan): *Trans. IECEJ*, vol. J63-B, no. 11, pp. 1063–1070, November 1980.

Distributed constant networks can be identified as digital filters by representing the Richard's variable of the lossless equal-length line as the function of z^{-1} (z-transform).

Microwave Integrated Circuits

1

Image Guide Ring Type Diplexer for Millimeter-Wave Integrated Circuits (Correspondence), by T. Itanami (Yokosuka Electrical Communication Laboratory, N.T.T., Yokosuka-shi, 238-03 Japan): *Trans. IECEJ*, vol. J63-B, no. 1, pp. 84–85, January 1980.

This paper describes the structure and transmission characteristics of a diplexer with maximally-flat frequency response. Experimental results at 51.8 GHz agree well with theoretical ones.

2

An 80-GHz Diplexer Using Alumina Image Lines (Correspondence), by N. Imai and K. Yamamoto (Yokosuka Electrical Communication Laboratory, N.T.T., Yokosuka-shi, 238-03 Japan): *Trans. IECEJ*, vol. J63-B, no. 10, pp. 1009–1010, October 1980.

This paper describes the optimum design method of a ring-type diplexer for millimeter-wave integrated circuits from the view point of miniaturization and low-loss property.

3

Microwave Integrated Circuits with High-Dielectric Constant Substrate for UHF Transistor Amplifiers, by T. Noguchi, Y. Kajiwara, Y. Sugiura, H. Katoh, and H. Takamizawa (Central Research Laboratories, Nippon Electric Co., Ltd., Kawasaki, 213 Japan): *Trans. IECEJ*, vol. E63, no. 12, pp. 842–848, December 1980.

The main features of microstrip lines on a high-dielectric-constant substrate are low impedance and short wavelength, which are useful to realize low-cost and small-size UHF power amplifiers. A compact 500-MHz band 12-W amplifier with a substrate ($\varepsilon_r = 139$) is described.

Microwave Thermal Effects

1

Microwave Heating with Mass Transfer, by T. Orikasa, M. Kimura, S. Washisu, and I. Fukai (Faculty of Engineering, Hokkaido University, Sapporo-shi, 060 Japan): *Trans. IECEJ*, vol. J63-B, no. 6, pp. 589–595, June 1980.

The temperature distribution in an object heated with microwave fields is estimated with the use of Luikov's system equations for the case where mass transfer and the evaporation of liquid can occur.

Microwave Holography

1

Image Reconstruction from Microwave Holography by Computer Tomography Technique (Correspondence), by M. Nishimura (Maizuru Technical College, Maizuru-shi, 625 Japan) and H. Shigesawa (Faculty of Engineering, Doshisha University, Kyoto-shi, 602 Japan): *Trans. IECEJ*, vol. J63-B, no. 1, pp. 85–87, January 1980.

The hologram data of an object are acquired along several oblique axes around the object. A CT-algorithm is used to reconstruct the image of the object with high resolution. The advantage of this holography is demonstrated by numerical simulation and experimental results at microwave frequencies.

2

Microwave Holography by Two-Dimensionally Rotational Scanning of Object (Correspondence), by K. Yamane and M. Matsuo (Faculty of Industrial Arts, Kyoto University of Industrial Arts and Textile Fibers, Kyoto-shi, 606 Japan): *Trans. IECEJ*, vol. J63-B, no. 9, pp. 943–944, September 1980.

Holograms with this imaging method are easily made in the form of the Fourier-transform hologram. The results of experiments with 8.6-mm waves are shown.

Optical Fibers

1

An Empirical Formula for Estimating the Baseband Bandwidth of Spliced Long Optical Fibers (Letters), by T. Tanifuji, T. Horiguchi, M. Tokuda (Ibaraki Electrical Communication Laboratory, N.T.T., 319-11 Japan), T. Matsumoto, and K. Hashimoto (Yokosuka Electrical Communication Laboratory, N.T.T., Yokosuka, 238-03 Japan): *Trans. IECEJ*, vol. E63, no. 1, pp. 39–40, January 1980.

A simple formula for estimating the baseband bandwidth of a transmission line made of different optical fibers spliced together is proposed and confirmed with experiments.

2

The Theoretical and Experimental Study of Mode-Coupled Multimode W-Fiber Based on Scattering Matrix Method, by H. Kajioka (Research Laboratory, Hitachi Cable, Ltd., Hitachi, 319-14 Japan): *Trans. IECEJ*, vol. E63, no. 6, pp. 414–420, June 1980.

A novel theory for analyzing the baseband transfer-function of a mode-coupled multimode fiber is described. Theoretical results of the transmission characteristics of multimode W-type fibers are compared with experimental results.

3

Transmission Characteristics of Optical Waveguide with Periodic External Force, by Y. Namihira, M. Kudo, and Y. Mushiake (Faculty of Engineering, Tohoku University, Sendai, 980 Japan): *Trans. IECEJ*, vol. E63, no. 6, pp. 429–436, June 1980.

This paper deals with the effect of core deformations caused by a periodic external force on the transmission characteristics of an optical fiber. A slab-waveguide model is used to analyze loss mechanism. Theoretical results are compared the results of experimental investigations on the excess loss of a single-mode fiber.

4

Mode Analysis of Optical Fibers by Vector Variational Method (Correspondence), by T. Hattori, M. Matsuhara, and N. Kumagai (Faculty of Engineering, Osaka University, Suita-shi, 565 Japan): *Trans. IECEJ*, vol. J63-C, no. 7, pp. 445–446, July 1980.

A simple, accurate vector variational method is proposed and applied to the analysis of a step-index fiber and a parabolic index fiber.

5

Baseband Frequency Characteristics of Optical Fibers (Correspondence), by K. Okada and I. Kobayashi (Yokosuka Electrical Communication Laboratory, N.T.T., Yokosuka-shi, 238-03 Japan): *Trans. IECEJ*, vol. J63-B, no. 8, pp. 816–818, August 1980.

A transversal filter model is used to estimate the refractive index profiles of graded-index optical fibers from the measured data of baseband and phase characteristics.

6

Polarization Transmission Characteristics of Optical Fibers with Elliptical Cross-Section, Y. Fujii and K. Sano (University of Tokyo, Tokyo, 106 Japan): *Trans. IECEJ*, vol. J63-C, no. 8, pp. 471–477, August 1980.

The transmission characteristics of the $e\mathrm{HE}_{11}$- and $o\mathrm{HE}_{11}$-mode of optical fibers with elliptical cross section are analyzed by using the matricized eigen-mode equation and an approximation method proposed by Yeh.

7

Random-Bend Loss—Evaluation in Single-Mode Optical Fiber with Various Index Profiles, by M. Kubota, K. Furuya, and Y. Suematsu (Faculty of Engineering, Tokyo Institute of Technology, Tokyo, 152 Japan): *Trans. IECEJ*, vol. E63, no. 10, pp. 723–730, October 1980.

The formula of random-bend loss is derived for an arbitrary index-profile. The loss is estimated as the radiation power of dipoles caused by refractive-index perturbation. The random-bend losses of four index-profiles are discussed.

8

Phase to Intensity Fluctuation Conversion of Laser Light on Propagation in Multimode Fibers, by K. Hayashi, Y. Yamamoto, and N. Hirano (Faculty of Engineering, Tokyo Denki University, Tokyo, 101 Japan): *Trans. IECEJ*, vol. J63-C, no. 12, pp. 824–831, December 1980.

This paper describes the conversion of the phase fluctuation of semiconductor laser light to the intensity fluctuation in an optical fiber due to the dispersion property of the fiber.

9

Controlled Mode Mixing and Realisable Bandwidth of Graded Index Fibers, by A. E. Karbowiak and D. H. Irving (School of Engineering, University of New South Wales, Kensington, N.S.W. 2033, Australia): *ATR*, vol. 13, no. 2, pp. 14–19, 1980.

A class of suboptimal graded index fibers is analyzed using a perturbation calculus to test the predictions on the equalization of a multimode optical fiber by a complementary fiber.

Optical Waveguides Other Than Fibers

1

An Analysis of Two Coupled Modes with Losses (Correspondence), by I. Awai and J. Ikenoue (Faculty of Engineering, Kyoto University, Kyoto-shi, 606 Japan): *Trans. IECEJ*, vol J63-B, no. 3, pp. 268–270, March 1980.

Coupled mode theory including the treatment of losses are described with the emphasis on its application to an optical mode filter fabricated on an anisotropic thin film.

2

Characteristic of an Optical Branching Waveguide in $LiNbO_3$, by K. Mitsunaga, M. Masuda, and J. Koyama (Faculty of Engineering, Osaka University, Suita-shi, 565 Japan): *Trans. IECEJ*, vol. J63-C, no. 3, pp. 178–185, March 1980.

The characteristics of an electrooptic branching waveguide in a Ti diffused $LiNbO_3$ crystal are analyzed, and compared with experimental results at the wavelength of 0.6328 μm.

3

Propagation Characteristics of Light Wave in a Periodically Corrugated Dielectric Film (Correspondence), by N. S. Chang and Y. Matsuo (Institute of Scientific and Industrial Research, Osaka University, Suita-shi, 565 Japan): *Trans. IECEJ*, vol. J63-C, no. 8, pp. 562–564, August 1980.

This paper describes the symmetrical Bragg interactions of the first-order in a dielectric thin film with sinusoidally corrugated surfaces in the case of the even TE modes.

4

Scattering Losses Caused by Irregular Boundary Interfaces and Refractive Index Fluctuations in a Thin-Film Waveguide (Letter), by J. Yamakita and K. Rokushima (Faculty of Engineering, University of Osaka Prefecture, Sakai, 591 Japan): *Trans. IECEJ*, vol. E63, no. 8, pp. 588–589, August 1980.

Comparative discussions on scattering losses due to an irregular boundary and refractive-index fluctuations in a thin-film waveguide are made in terms of coupled-power coefficients.

5

Optical Propagation and Conversion Properties of Hybrid Modes in YIG Thin-Film Waveguides on GGG Substrates Using Faraday Effects with Isotropic Top Layers, by K. Taki, Y. Miyazaki, and Y. Ando (Faculty of Engineering, Nagoya University, Nagoya, 464 Japan): *Trans. IECEJ*, vol. E63, no. 10, pp. 754–761, October 1980.

Gyrotropic thin-film waveguides with isotropic top layers are discussed in terms of hybrid modes. Such structures are useful for constructing optical isolators. The design data of some nonreciprocal circuits are obtained from the hybrid mode analysis.

Optical Devices

1

Cut Off Mode Filter with the Structure of Metal-Clad Optical Strip Line, by M. Itoh, M. Kudo, and Y. Mushiake (Faculty of Engineering, Tohoku University, Sendai-shi, 980 Japan): *Trans. IECEJ*, vol. J63-C, no. 3, pp. 164–171, March 1980.

A new three-dimensional mode filter using a metal-clad optical strip line is proposed. The transmission characteristics of the mode filter are investigated both theoretically and experimentally.

2

Turning Points of Rays in a Luneburg Lens (Correspondence), by H. Kotajima (Faculty of Engineering, Hosei University, Koganei-shi, 184 Japan): *Trans IECEJ*, vol. J63-B, no. 4, pp. 387–388, April 1980.

It is shown that all the turning points of parallel incident rays lie on the lens sphere. The geometrical properties of the turning point lead to a simple graphical method to determine the position of the point and the direction of rays at the point.

3

A Light Intensity Modulator Using pn Junction in GaAlAs (Correspondence), by S. Ohke, A. Kusunoki, Y. Cho, and Y. Matsuo (Institute of Scientific and Industrial Research, Osaka University, Suita-shi 565 Japan): *Trans. IECEJ*, vol. J63-C, no. 5, pp. 319–320, May 1980.

This new modulator uses the cut-off modulation effect of a GaAlAs waveguide built on a GaAs substrate. Two different structures for TE- and TM-like waves are presented.

4

Optical Heterodyne Detection of an Airy Signal Field with a Gaussian Local Oscillator Field, by T. Takenaka, N. Saga, and O. Fukumitsu (Faculty of Engineering, Kyushu University, Fukuoka-shi, 812 Japan): *Trans. IECEJ*, vol. J63-C, no. 7, pp. 423–429, July 1980.

The heterodyne efficiency of an optical heterodyne detector is calculated for the case where the local Gaussian field is applied to the Airy field. Effects of the tilt and off-axis of the local field on the efficiency are also discussed.

5

A Guided-Wave Acoustooptic Tunable Filter Making Use of Collinear TE–TM Mode Conversion (Letters), by M. Izutsu, M. Kato, and T. Sueta (Faculty of Engineering Science, Osaka University, Osaka, 560 Japan): *Trans. IECEJ*, vol. E63, no. 7, pp. 532–533, July 1980.

A novel filter structure composed of an optical waveguide ($LiNbO_3$) and an over layer (As_2S_3) on it is proposed for realizing specified filter performance by the adjustment of waveguide parameters.

6

Image Formation in Two-Photon-Resonant Image Upconverters (Correspondence), by S. Sasaki, T. Mishima, and I. Sakuraba (Faculty of Engineering, Hokkaido University, Sapporo-shi, 060 Japan): *Trans. IECEJ*, vol. J63-C, no. 8, pp. 561–562, August 1980.

An object-image matrix is derived by a paraxial ray tracing analysis. A formula is obtained which relates the location of the image to that of the object and the two pump sources.

7

Thickness Aberrations in Two-Photon-Resonant Image Upconverters, by S. Sasaki, T. Mishima, and I. Skuraba (Faculty of Engineering, Hokkaido University, Sapporo-shi, 060 Japan): *Trans. IECEJ*, vol. J63-C, no. 9, pp. 593–600, September 1980.

An image produced by an image up-converter with two-photon pumping in a medium of finite thickness is analyzed with the object–image matrix method. Conditions for correcting longitudinal aberration and thickness coma are shown.

8

Electro-Optical Deflector with ZnO Thin Film (Correspondence), by Y. Nakagawa (Faculty of Engineering, Yamanashi University, Kofu-shi, 400 Japan): *Trans. IECEJ*, vol. J63-C, no. 9, pp. 645–646, September 1980.

The guided electrooptical interaction in a ZnO thin film as a low-voltage deflector is analyzed and compared with experimental results.

9

Coupling Efficiency of Tapered Grating Optical Coupler (Correspondence), by Y. Makita, M. Matsuhara, and N. Kumagai (Faculty of Engineering, Osaka University, Suita-shi, 565 Japan): *Trans. IECEJ*, vol. J63-C, no. 10, pp. 718–719, October 1980.

This paper gives a theoretical analysis of a tapered grating optical coupler whose coupling coefficient varies with the direction of propagation. This coupler has a high efficiency for the case of a Gaussian beam incident.

10

Electrically Deformable Echelette Grating—Application to Tunable Laser Resonator, by T. Utsunomiya and H. Sato (Department of Electrical Engineering, National Defence Academy, Yokosuka-shi, 239 Japan): *Trans. IECEJ*, vol. J63-C, no. 10, pp. 675–681, October 1980.

Piezoelectric thin-plates are used to compose the top surface of an Echelette grating. The period and shape of the grating grooves are changed with the applied electric field. The application of this grating to a CO_2 laser and Ar^+ laser is discussed.

11

A New Optical Heterodyne Detector with Integrated Diffraction Grating (Correspondence), by H. Sakaki, Y. Fujii, and M. Misawa (University of Tokyo, Tokyo, 106 Japan): *Trans. IECEJ*, vol. J63-C, no. 10, pp. 710–711, October 1980.

The wave-front matching of signal wave and local wave in this heterodyne detector are achieved with a diffraction grating integrated on the detector surface.

12

Difference-Frequency Generation in Three-Dimensional $LiNbO_3$ Optical Waveguide, by N. Uesugi (Musashino Electrical Communication Laboratory, N.T.T., Musashino-shi, 180 Japan): *Trans. IECEJ*, vol. J63-C, no. 11, pp. 737–744, November 1980.

The phase matching condition, tuning characteristics, and conversion efficiency for the difference frequency generation are described. The results of experiments at the wavelength of 1.318 μm are shown.

13

The Effect of Errors in Layer Thickness and Refractive Index on Transmission Property of TiO_2–SiO_2 Interference Filters (Correspondence), by K. Miyazaki, A. Okamoto, H. Nakajima, and N. Tokoyo (Fujitsu Laboratories Ltd., Kawasaki-shi, 211 Japan): *Trans. IECEJ*, vol. J63-C, no. 11, pp. 800–801, November 1980.

This paper describes the increase of transmission loss and the decrease of edge steepness of TiO_2–SiO_2 edge filters due to the random variation of the layer thickness and refractive index.

14

0 to 18 GHz Traveling-Wave Optical Waveguide Intensity Modulator (Letters), by M. Izutsu, H. Haga, and T. Sueta (Faculty of Engineering Science, Osaka University, Toyonaka, 560 Japan): *Trans. IECEJ*, vol. E63, no. 11, pp. 817–818, November 1980.

A traveling-wave light intensity modulator was made using a strip optical waveguide of 5-μm width and asymmetric strip electrodes. The half-wavelength voltage of 23 V and the extinction ratio of 97 percent were achieved.

15

Second Harmonic Generation in Three-Dimensional $LiNbO_3$ Optical Waveguide, by N. Uesugi (Musashino Electrical Communication Laboratory, N.T.T., Musashino-shi, 180 Japan): *Trans. IECEJ*, vol. J63-C, no. 12, pp. 809–816, December 1980.

This paper describes theoretical and experimental results of the second harmonic generation in a three-dimensional optical waveguide made of $LiNbO_3$. The measured efficiency was 0.77 percent.

Measurements

1

Backscattering Measurement and Fault Location in Optical Fibers, by K. Okada and I. Kobayashi (Yokosuka Electrical Communication Laboratory, N.T.T., Yokosuka-shi, 238-03 Japan): *Trans. IECEJ*, vol. J63-B, no. 2, pp. 159–166, February 1980.

This paper describes a backscattering measurement technique and its application to fault location and to the measurement of distributed loss. The detectable range of fault location was up to 6.8 km for an optical fiber with the loss of 2.5 dB/m at 0.85 μm.

2

Optical Loss Measurement in Graded-Index Fiber in the Field, by M. Tateda, M. Tokuda, T. Horiguchi, and N. Uchida (Ibaraki Electrical Communication Laboratory, N.T.T., Ibaraki-ken, 319-11 Japan): *Trans. IECEJ*, vol. J63-B, no. 5, pp. 436–443, May 1980.

This paper describes the use of an auxiliary optical fiber, called a dummy fiber, for the loss measurement of optical fibers and shows the results of the loss measurement of cabled optical fibers in the field trial in Tokyo in 1978.

3

Measurement of Optical Fiber Loss and Splice Loss by Backscatter Method, by M. Nakahira, M. Tokuda, K. Omote, N. Uchida, and H. Fukutomi (Ibaraki Electrical Communication Laboratory, N.T.T., Ibaraki, 319-11 Japan): *Trans. IECEJ*, vol. E63, no. 10, pp. 762–767, October 1980.

The backward Rayleigh scattering effect in optical fibers is used to measure the optical fiber loss and splice loss with the accuracy of ± 0.04 dB. The application of this method to fault location is also described.