Asian Abstracts

Papers from Journals Published in Australia, India, and Japan in 1986

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The periodicals investigated are 1) *Transactions of the Institute of Electronics and Communication Engineers of Japan* (*Trans. IECEJ*), 2) *Journal of the Institution of Electronics and Telecommunication Engineers*, India (*JIETE*), 3) *Journal of Electrical and Electronics Engineering*, Australia (*JEEE*), and 4) *Australian Telecommunication Research* (*ATR*).

As for the Japanese papers in the *Trans. IECEJ* which carry volume numbers J69-B and J69-C, short English summaries are found in the *Trans. IECEJ*, vol. E69, issued in the same month. Papers carrying volume number E69 are papers originally written in English. These 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.

The abstracts of these papers are grouped as follows:

1) Solid-State Microwave Devices and MMIC
2) Transmission Lines and Passive Microwave Devices
3) Microwave Antennas
4) Microwave Propagation and Scattering
5) Microwave Medical/Biological Applications
6) Lasers and Other Devices
7) Optical Fibers/Waveguides
8) Superconductive Devices

1) Solid-State Microwave Devices and MMIC

1

High Efficiency Sinusoidal Oscillations in Bulk GaAs (Letters), by T. Hayashi*, A. Hasegawa**, and R. B. Uehlein*** (*Faculty of Engineering, Shizuoka University, Hamamatsu, 432 Japan; **Faculty of Engineering, Chiba University, Chiba 260 Japan; ***Bell Laboratories, Murray Hill, NJ, U.S.A.): *Trans. IECEJ*, vol. J69-C, pp. 162–164, Apr. 1986.

A high efficiency sinusoidal current oscillation with a frequency of about 700 MHz has been observed in n-type GaAs bulk. From experiments, it is supposed that this oscillation is not Gunn nor LSA oscillation but an oscillation due to the optical phonon and electron stream interaction.

2

A Boundary Element Approach to Field Analysis of Junction-Gate Field Effect Transistors, by Y. Tanaka, T. Sasaki, T. Honma, and I. Kaji (Faculty of Engineering, Hokkaido University, Sapporo, 060 Japan): *Trans. IECEJ*, vol. E69, pp. 148–156, Feb. 1986.

A new boundary integral formulation is presented in order to solve a general Laplace-Poisson's equation, which is one of the basic equations of semiconductor devices. The potentials and electric field intensities at interface nodes put between a Laplace and a Poisson domain are analytically calculated.

3

Extremely Low-Noise HEMT Fabricated on MOCVD Epi-Wafer (Letters), by H. Kawasaki, I. Inami, A. Tanaka, H. Tokuda, M. Higashiura, and S. Hori (Komukai Works, Toshiba Corp., Kawasaki, 210 Japan): *Trans. IECEJ*, vol. E69, pp. 294–295, Apr. 1986.

In this letter, 0.25-μm gate low-noise high electron mobility transistors (HEMTs), using epitaxial wafers grown by metal-organic-chemical vapor deposition (MOCVD) technique have been developed. Minimum noise figures of 0.75 dB and 1.2 dB with associated gains of 11.1 dB and 7.9 dB are obtained at 12 GHz and 18 GHz, respectively, at room temperature.

4

Analysis of Layer Number Dependence of Response Time and Current Gain of Resonant Electron Transfer Triode (Letters), by Y. Nakata, M. Asada, Y. Suematsu, and M. Sato (Faculty of Engineering, Tokyo Institute of Technology, Tokyo, 152 Japan): *Trans. IECEJ*, vol. E69, pp. 305–306, Apr. 1986.

In order to obtain higher speed in a resonant-electron-transfer triode, the dependence of the metal layer number upon response time and current gain is investigated. It is shown that the response time becomes longer and the gain becomes higher by decreasing the layer number.

5

A 20 GHz Band Monolithic Low Noise Amplifier Using GaAs ADVANCED SAINT-FET (Letters), by M. Muraguchi, T. Enoki, K. Yamasaki, and K. Ohwada (NTT Electrical Communications Labs., Atsugi, 243-01 Japan): *Trans. IECEJ*, vol. E69, pp. 326–328, Apr. 1986.

A 20-GHz band monolithic low noise amplifier is made by SAINT (Self-aligned implantation for N^+ layer technology). The circuit is designed so as to give the lowest noise figure. The amplifier has a measured noise figure less than 3.5 dB with a minimum gain of 4.2 dB over a 18.5- to 20-GHz range. The optimum noise figure is 2.9 dB with a gain of 5.5 dB at 19 GHz. Typical threshold-voltage deviation of monitor FETs is within 70 mV over the entire area of a 2-inch wafer.

6

26 GHz Band "Planar MMIC" Hybrid Circuit (Letters), by Y. Tarusawa, H. Ogawa, and K. Ohwada (NTT Electrical Communications Labs., Yokosuka, 238 Japan): *Trans. IECEJ*, vol. E69, pp. 329–330, Apr. 1986.

A circuit configuration suitable for MMICs (Monolithic Microwave Integrated Circuit) has been proposed. Slot lines and coplanar lines are constructed on one side of the substrate. Circuits are realized on one plane. Via-holes and ground metallization, which are needed in stripline configuration, are not required.

7

Ultra-High-Speed GaAs BFL Binary Frequency Divider (Letters), by K. Osafune, K. Ohwada, and N. Kato (NTT Electrical Communications Labs., Atsugi, 243-01 Japan): *Trans. IECEJ*, vol. E69, pp. 536–543, Apr. 1986.

Ultra-high-speed, master-slave, flip-flop circuits are designed and fabricated using buffered GaAs MESFET logic (BFL) circuits with source follower architecture. Newly developed buried p-layer SAINT-FETs with a 0.5-μm gate length by electron-beam lithography are used in the frequency divider IC process. The maximum operating frequency of the binary frequency divider is 6.8 GHz with a power consumption of 350 mW.

8

I–V Characteristics of Photodetector Using the GaAs MESFET, by T. Umeda and Y. Cho (The Institute of Scientific and Industrial Research, Osaka University, Ibaraki, 567 Japan): *Trans. IECEJ*, vol. J69-C, pp. 623–628, May 1986.

Variations of I–V characteristics in a GaAs MESFET under light illumination condition have been theoretically and experimentally investigated. Experimentally observed results are explained by an optically controlled channel current model, which has previously been proposed by the authors. It is also confirmed that the output current vs. input power characteristic is well described by this model.

9

Boundary Decision for a Depletion Region in Semiconductor Devices, by Boundary Element Method (Letters), by K. Ono*, and M. Naito** (*Hitachi Research Laboratory, Hitachi Ltd., Hitachi, 319-12 Japan; **Advanced Research Laboratory, Hitachi Ltd., Kokubunji, 185 Japan): *Trans. IECEJ*, vol. J69-C, pp. 695–697, May 1986.

Boundary element method is applied to determine the depletion region in semiconductor devices. The position of the nodal points is iteratively corrected so that the potential at each node on the depletion boundary coincides with the applied voltage. A numerical example for a reversed p-n diode is shown.

10

Coupling Coefficients and Injection-Locking Characteristics of Microwave Oscillators, by K. Fukumoto* and M. Nakajima** (*IC Group, Sharp Corporation, Tenri, 632 Japan; **Faculty of Engineering, Kyoto University, Kyoto, 606 Japan): *Trans. IECEJ*, vol. J69-B, pp. 698–705, July 1986.

The injection-locking characteristics of an oscillator are different in the low frequency region and in the microwave region. This paper investigates this difference by introducing the traveling wave concept in the input and output signals. It also indicates that two parameters for a coupled oscillator system, the coupling between an oscillator and the transmission line and a parameter of the coupling circuit, should be introduced.

11

Noise in an IMPATT Diode Oscillator with 2nd Harmonic Signals, by M. Fukushima (Faculty of Engineering, Shimane University, Matsue, 690 Japan): *Trans. IECEJ*, vol. J69-C, pp. 947–955, Aug. 1986.

The FM and AM noises of an IMPATT oscillator, in which the fundamental and the 2nd harmonic oscillations exist, are analyzed. The optimum phase between the fundamental and 2nd harmonics to reduce noise is discussed.

12

Microwave Oscillator Using Magnetostatic Surface Wave Delay Lines (Letters), by M. Tsutsumi (Faculty of Engineering, Osaka University, Suita, 565 Japan): *Trans. IECEJ*, vol. J69-C, pp. 1061–1063, Aug. 1986.

A microwave oscillator is fabricated using magnetostatic surface wave delay line in a feedback loop of a 2–4-GHz FET amplifier. Metal grid arrays with a long periodicity of 1 mm have been designed in order to select the single mode of oscillation. The oscillation frequency and power profile as a function of magnetic field are presented.

13

Stabilization of Gunn Oscillator Using Two Band-Rejection Cavities (Letters), by N. S. Chang (Faculty of Communication Engineering, Osaka Electro-Communication University, Neyagawa, 572 Japan): *Trans. IECEJ*, vol. J69-C, pp. 1370–1372, Oct. 1986.

A theoretical and experimental investigation for stabilizing the frequency of a Gunn oscillator by utilizing two band rejection cavities is presented. It is shown that the stabilization by two cavities produces better stability compared with a single cavity.

14

A Highly Stabilized FET Oscillator for Ku-Band Receiver, by K. Shinkawa and M. Noda (Consumer Products Research Center, Hitachi, Ltd., Yokohama, 244 Japan): *Trans. IECEJ*, vol. J69-B, pp. 1415–1421, Nov. 1986.

A low cost and highly stabilized Ku-Band oscillator with a common-drain GaAs FET and a very high Q dielectric resonator has been developed. The oscillation condition of the oscillator is calculated from small-signal FET parameters. It has been found that the deviation of oscillation frequency can be reduced by adding a capacitive admit-

tance to the source output port of the oscillator. A deviation less than ± 600 kHz over a temperature range from $-20°C$ to $+60°C$ has been obtained.

15

Low-Noise Amplifiers for Terrestrial and Satellite Communication Systems, by M. N. Vyas, V. L. Rao, and S. Venkatsubramanian (Bharat Electronics Ltd., Ghaziabad 201 008 India): *JIETE* (India), vol. 32, pp. 113–117, May–June 1986.

The paper presents design approach for realizing amplifiers for 1.7 to 2.1 GHz, 2.1 to 2.3 GHz, 2.3 to 2.5 GHz, 2.5 to 2.7 GHz frequency bands. The gain ripple and bandwidth perturbations due to the deviation from the exact insertion loss function are minimized using performance optimization. Two stage GaAs-FET amplifiers are realized using the above approach. Performance test results are also included for the developed amplifiers.

16

A Low-Noise Microwave Frequency Synthesizer Using Varactor Tuned Dielectric Resonator Oscillator (Letters), by G. K. Yogeshwar, V. P. Singh, K. P. Rangari, and C. K. Chatterjee (Defence Electronics Applications Laboratory, Dehra Dun 248 001 India): *JIETE* (India), vol. 32, pp. 134–136, May–June 1986.

A varactor-tuned low-noise GaAs FET oscillator having with a low-loss, high-Q and high temperature stable bariumtitanate dielectric resonator has been developed. The oscillator is phase-locked with highly-stable VHF crystal reference using mix and count-down technique. It has been developed for a low-noise synthesizer in the 5.90- to 6.00-GHz band with 10-kHz resolution to be used as the local oscillator in satellite ground terminals.

17

Down Converter for SHF Frequency Band (Letters), by R. M. Jain, S. K. Jindal, V. V. R. Sarma, and C. K. Chatterjee (Defence Electronics Applications Laboratory, Dehra Dun 248 001 India): *JIETE* (India), vol. 32, pp. 136–138, May–June 1986.

A dual-stage down-conversion mixer has been designed for use at 7/8 GHz. Both the mixer stages provide low conversion loss and very good isolation. MIC guide as well as MIC slot line configuration have been used for the first RF stage. In the MIC guide mode, the mixer is tunable over a 8–12-GHz band having an instantaneous bandwidth of 200 MHz and a conversion loss of 4.0 dB. In the MIC slot line mode, more than 25-dB isolation and a conversion loss of 6 dB has been achieved over a 10-percent bandwidth.

18

A New Solid-State Device as a Source of Power in mm Wave, by B. B. Pal, R. U. Khan, and P. Chakrabarti (Microelectronics Laboratory, Department of Electronics Engineering, Institute of Technology, Banaras Hindu University, Varanasi 221 005 India): *JIETE* (India), vol. 32, pp. 397–402, Sept.–Oct. 1986.

A new solid-state transit time device named double DOVATT has been suggested as a power source in the millimeter-wave range. The device is capable of delivering power at high efficiency even in the millimeter-wave range. The double DOVATT can give powers of the same order of and efficiencies higher than those of DDR heterojunction Impatts.

19

Efficient FM–AM Conversion through Injection-Locking of an X-Band Gunn Oscillator, by T. P. Chattopadhyay (Radionics Laboratory, Department of Physics, Burdwan University, Burdwan 713 104 India): *JIETE* (India), vol. 32, pp. 428–434, Nov.–Dec. 1986.

This paper describes experimental observations on the amplitude modulation of a 9.347-GHz Gunn oscillator when it is injection-locked by an FM signal. The dependence of both the FM–AM conversion efficiency and the harmonic distortion of the detected signal on the system parameters is discussed in detail. It is shown that an injection-synchronized microwave oscillator can be used as an efficient FM–AM converter.

20

Second Harmonic Operation of X-Band Gunn Devices (Letters), by A. K. Aggarwal, U. C. Ray, R. Gulati, and I. Chandra (Solid-State Physics Laboratory, Lucknow Road, Delhi 110 007 India): *JIETE* (India), vol. 32, pp. 451–452, Nov.–Dec. 1986.

GaAs Gunn devices are being increasingly used in the harmonic mode to deliver appreciable power in the millimeter-wave band. In this paper, the second harmonic response of X-band Gunn devices is investigated. The circuit requirements and experimental results obtained in a conventional resonant disc type oscillator circuit are discussed.

2) Transmission Lines and Passive Microwave Devices

1

SAW Propagation Characteristics in Thin-Film Surface Acoustic Waveguides for Acouto-Optic Devices, by N. Goto* and Y. Miyasaki** (*Faculty of Engineering, Nagoya University, Nagoya, 464 Japan; **Faculty of Engineering, Toyohashi University of Technology, Toyohashi, 440 Japan): *Trans. IECEJ*, vol. E69, pp. 47–55, Jan. 1986.

Acoustic waveguide constructions suited for acousto-optic devices and their materials are studied. The characteristics of the waveguides, velocity dispersion, insertion loss, and cross-section profiles are discussed.

2

Accurate Numerical Analysis of Inductive Windows in a Rectangular Waveguide by Singular Integral Equations, by A. Matsushima and T. Itakura (Faculty of Engineering, Kumamoto University, Kumamoto 860 Japan): *Trans. IECEJ*, vol. J69-B, pp. 62–70, Jan. 1986.

A time-efficient numerical computation method for solving the electromagnetic scattering by inductive windows in a rectangular waveguide is proposed. The method is based upon solving the singular integral equations. For a single window, a quasi-static approximation is applied. For multiple windows, a set of integral equations are directly solved by Galerkin's procedure.

3

Reflecting Characteristics of Lossy Anisotropic Materials Inserted into the Rectangular Waveguide, by O. Hashimoto* and Y. Shimizu** (*Faculty of Engineering, Tokyo Institute of Technology, Tokyo, 152 Japan; **The Center for Research and Development of Educational Technology, Tokyo Institute of Technology, Tokyo, 152 Japan): *Trans. IECEJ*, vol. J69-B, pp. 179–188, Feb. 1986.

Reflection coefficients of lossy anisotropic material fixed on a short-circuited plate of a rectangular waveguide are theoretically and experimentally discussed. Various hybrid modes in the material are derived from a generalized telegraph's equation. Reflection coefficients are calculated by the numerical method based on the mode matching method. A rubber sheet manufactured by rolling process is measured. The theoretical results show good agreement with the measured results.

4

Surface Acoustic Wave Convolver Using Multiple Waveguide, by Y. Nakagawa and S. Makio (Faculty of Engineering, Yamanashi University, Kofu, 400 Japan): *Trans. IECEJ*, vol. J69-C, pp. 190–198, Feb. 1986.

Theoretical and experimental results are reported for a new type of surface acoustic wave (SAW) convolver using a multiple waveguide fabricated on a YZ-$LiNbO_3$ substrate. The convolution signal is obtained from an output interdigital transducer which picks up the SAW propagating in the direction normal to the waveguide. Then the convolution efficiency is higher than that of the conventional SAW convolver.

5

Effect of Doping Carbon in an Electromagnetic Wave Absorber, Rubber Ferrite, by Y. Naito and T. Mizumoto (Faculty of Engineering, Tokyo Institute of Technology, Tokyo, 152 Japan), vol. J69–C, pp. 257–261, Mar. 1986.

Carbon doping into rubber ferrite is investigated to reduce thickness of the absorber. It is shown that about 30% reduction of thickness is realized at 1600 MHz and 4000 MHz by doping carbon compared with a rubber ferrite without carbon.

6

An Asymmetrical Suspended Stripline Directional Coupler (Letters), by O. Ishida*, Y. Isota*, Y. Miyazaki*, F. Takeda*, and N. Takeuchi** (*Information Systems and Electronics Development Lab. Mitsubishi Electric Corp., Kamakura, 247 Japan; **Communication Equipment Works, Mitsubishi Electric Corps. Amagasaki, 661 Japan): *Trans. IECEJ*, vol. E69, pp. 333–334, 1986.

An asymmetrical suspended stripline directional coupler with a coupling ranging from 5 to 9 dB has been designed and constructed. Metal strips are asymmetrically placed on both sides of the suspended dielectric. A good agreement between the measured and calculated coupling values has been obtained.

7

Dielectric Rod Resonators Having High Value of Unloaded Q (Letters), by Y. Kobayashi and Y. Kabe (Faculty of Engineering, Saitama University, Urawa, 338 Japan): *Trans. IECEJ*, vol. E69, pp. 335–337, Apr. 1986.

The resonant frequency, loss, and unload Q of a dielectric resonator in which dielectric rod is imbedded into a conductor cavity are analyzed. From the analysis, it is shown that the unloaded Q of such resonators can be made larger than that of conductor cavity.

8

Reflection and Transmission Characteristics of Step Discontinuity in a Rectangular Dielectric Waveguide (Letters), by Y. Tomabechi and K. Matsumura (Faculty of Engineering, Utsunomiya University, Utsunomiya, 321 Japan): *Trans. IECEJ*, vol. E69, pp. 338–340, Apr. 1986.

The reflection and transmission characteristics at an abrupt step discontinuity in the rectangular dielectric waveguide are analyzed by using double Fourier transformation. It is also shown that this method is applicable to large step discontinuities.

9

A Study on Reflection Characteristics of Lossy Anisotropic Rubber Sheets (Letters), by O. Hashimoto* and Y. Shimizu** (Faculty of Engineering, Tokyo Institute of Technology, Tokyo, 152 Japan; **The Center for Research and Development of Educational Technology, Tokyo Institute of Technology, Tokyo, 152 Japan.): *Trans. IECEJ*, vol. E69, pp. 341–343, Apr. 1986.

The characteristics of reflected wave from a lossy anisotropic sheet are measured using the short pulse method. It has been experimentally and theoretically confirmed that the reflection loss can be reduced by using the polarization conversion.

10

Small Size Waveguides with Periodically Loaded Posts, by K. Kim and S. Tokumaru (Faculty of Science and Technology, Keio University, Yokohama, 223, Japan): *Trans. IECEJ*, vol. J69-B, pp. 364–371, Apr. 1986.

A small-size rectangular waveguide having periodically loaded posts is proposed. The phase constants, field distributions, normalized transmission powers and attenuations are calculated. It is shown that the slow or fast wave modes are transmitted, which can be controlled by reactances externally loaded to the posts located on the outside of the waveguides. The experimental result for the phase

constant and attenuation coefficient agrees with the theoretical analysis.

11

Boundary Element Analysis of Electromagnetic Fields in a Lossy Dielectric Cavity (Letters), by K. Sakai (Kushiro Technical College, Kushiro, 084 Japan): *Trans. IECEJ*, vol. J69-B, pp. 406–408, Apr. 1986.

The boundary condition for the boundary element method is derived based upon the surface impedance assumption. The electric fields in a lossy dielectric cavity are analyzed using this condition. It is shown that computed results coincide with measured values.

12

Theoretical Analysis of the Double Ridge Ladder Type Delay Equalizer (Letters), by F. Ishihara (Faculty of Engineering, The Tamagawa University, Machida, 194 Japan): *Trans. IECEJ*, vol. J69-B, pp. 412–414, Apr. 1986.

It is theoretically proved that the double ridge ladder type line is useful for delay equalizer.

13

12–14 GHz Band Transmit-Receive Multiplexer for Broadcasting Satellite Transponders, by T. Nomoto (NHK Science and Technical Research Laboratories, Tokyo, 157 Japan): *Trans. IECEJ*, vol. J69-C, pp. 397–405, Apr. 1986.

The transmit-receive multiplexer consists of a 4-channel contiguous band multiplexer to combine high-power TWT outputs in the 12-GHz band, a 14-GHz band bandstop filter with small insertion loss, and a 14-GHz band bandpass filter to receive very low level input signals. This multiplexer, which has an insertion loss of 0.7 dB at each channel output and an isolation more than 80 dB between transmit-receive bands, satisfies the specifications for satellite transponders.

14

Field Analysis of an Open-Ended Parallel-Plate Waveguide (BEM Solution and Experiment), by K. Miyata* and M. Suzuki** (* Electrical Engineering Department, Akita National College of Technology, Akita, 011 Japan; **Faculty of Engineering, Hokkaido University, Sappopro, 060 Japan): *Trans. IECEJ*, vol. E69, pp. 651–658, May 1986.

In order to examine the feasibility of the boundary element method (BEM) for radiation problems in an unbounded region and the effects of choke loading on a waveguide aperture field and radiation patterns, numerical computations and measurements with a two dimensional model are conducted. It has been found that the input VSWR and the aperture field distribution are affected by the dimension of the choke. The measured electric fields coincide with the numerically predicted values. Good feasibility of the BEM approach is shown.

15

Finite Element Analysis of the Waveguide Eigenmodes (A Novel Method to Employ the Transverse Electromagnetic Fields), by M. Matsuhara, T. Angkaew, and N. Kumagai (Faculty of Engineering, Osaka University, Suita, 565 Japan): *Trans. IECEJ*, vol. J69-C, pop. 548-553, May 1986.

In the finite element method there are some cases where spurious modes appear in the solution. In this paper, a novel variational expression of the propagation constant, in which spurious modes are eliminated, is presented. The propagation constant is expressed by the transverse electromagnetic fields. This method is based upon imposing a simple condition that the propagation constant of the eigenmode is real.

16

High-Power Nonreciprocal Ferrite Phase Shifter Using Unsymmetrical Ridged Waveguide, by H. Kataoka, K. Ohwi and F. Okada (The National Defense Academy, Yokosuka, 239 Japan): *Trans. IECEJ*, vol. J69-C, pp. 563–570, May 1986.

A nonreciprocal ferrite phase shifter using symmetrical ridged waveguide for high-power isolators is presented. The advantage of this phase shifter is that the differential phase shift characteristic is improved and the ferrite can easily be water-cooled. The field distribution and the differential phase shift of the ridged phase shifter are analyzed. These results agree with the experimental results.

17

Representation of Coupling Characteristics of Crossing Striplines by Poynting Vector (Letters), by S. Koike, N. Yoshida, and I. Fukai (Faculty of Engineering, Hokkaido University, Sapporo, 060 Japan): *Trans. IECEJ*, vol. E69, pp. 713–715, June 1986.

Three-dimensional behavior of Poynting vectors for crossing striplines is presented. The coupling of the striplines is evaluated by the surface integral of Poynting vectors.

18

The Measurement of Complex Permittivity Tensor of Lossy Anisotropic Sheet by Standing Wave Method of Rectangular Waveguide, by O. Hashimoto* and Y. Shimizu** (*Faculty of Engineering, Tokyo Institute of Technology, Tokyo, 152 Japan; **The Center of Research and Development of Educational Technology, Tokyo Institute of Technology, Tokyo, 152 Japan): *Trans. IECEJ*, vol. J69-B, pp. 640–650, June 1986.

The measurement method is studied for complex permittivity tensor of rubber sheet placed in the rectangular waveguide by the standing wave method. The tensor including nondiagonal elements and its principal direction are measured and discussed. Errors in the measured tensor elements and principal direction are evaluated.

19

Finite-Element Analysis of Dielectric Slab Waveguide with Finite Periodic Corrugation, by K. Hirayama, M. Koshiba, and M. Suzuki (Faculty of Engineering, Hokkaido Univer-

sity, Sapporo, 060 Japan): *Trans. IECEJ*, vol. J69-C, pp. 724–730, June 1986.

A numerical analysis based on the finite-element method is described for the analysis of the discontinuity problem of both TE and TM modes in a dielectric slab waveguide with finite periodic corrugation. To treat a large periodic-structure and the entire mode spectrum, a substructure and an approximate bounded approach have been introduced.

20

Properties of Linear Tapered Cutoff Waveguide Filters, by H. Shirasaki and F. Ishihara (Faculty of Engineering, Tamagawa University, Machida, 194 Japan): *Trans. IECEJ*, vol. J69-B, pp. 715–721, July 1986.

Reflection and transmission coefficients of a linearly tapered cutoff waveguide are obtained by solving numerical differential equations. Experimental values will agree with calculated values in the X-band.

21

Analysis of Finite Periodic Waveguides for Elastic Waves Using Finite-Element Method, by K. Hasegawa, M. Koshiba, and M. Suzuki (Faculty of Engineering, Hokkaido University, Sapporo, 060 Japan): *Trans. IECEJ*, vol. J69-C, pp. 865–873, July 1986.

A numerical analysis of finite periodic waveguides for elastic waves is presented. The analysis is based upon the finite-element method. Numerical examples are shown for Rayleigh-wave reflection characteristics of groove arrays. In this analysis, the interaction of surface waves and bulk waves in all grooves is taken into account. Obtained results approximately agree with the experimental results reported so far.

22

Propagation Characteristics of Electromagnetic Waves in Groove Guides, by Y. Yamaguchi, Y. Ohtaki, and T. Abe (Faculty of Engineering, Niigata University, Niigata, 950-21 Japan): *Trans. IECEJ*, vol. J69-B, pp. 842–847, Aug. 1986.

In this paper, a simple ray method is applied to determine the propagation characteristics of radio waves along a road surrounded by buildings or snow packs. It is shown that the calculated field intensities on the road well agree with the experimental results obtained in the laboratory, and that the propagation loss along the road decreases with frequency.

23

A Method of Pass-Frequency Adjustment for Waveguide-Type Dielectric Filters (Letters), by H. Kubo, and S. Kurazono (Faculty of Engineering, Osaka University, Suita, 565 Japan): *Trans. IECEJ*, vol. J69-B, pp. 1027–1028, Sept. 1986.

A method for adjusting the center frequency of the pass band of waveguide-type dielectric filters is proposed. The numerical analysis is done by the boundary element method. It is shown that the center frequency can be adjusted by varying the shape of the waveguide wall without changing the bandwidth.

24

Study of Matching Load on Non-Uniform Coaxial Transmission Line and Its Application to Wideband Impedance Transformer, by S. Sano, M. Mochizuki, S. Muto, C. Ito, and H. Ito (Faculty of Engineering, Yamanashi University, Koufu, 400 Japan): *Trans. IECEJ*, vol. J69-C, pp. 1134–1139, Sept. 1986.

The characteristic impedance of nonuniform coaxial transmission line is calculated from the telegraph's equation. It has been found that the transmission lines with parabolic and sinusoidal shapes operate as a wideband impedance transformer.

25

Design of Microwave Power Combiner with Circular TM_{0m0} Mode Cavity, by H. Matsumura, and H. Mizuno (NHK Science and Technical Research Laboratories, Tokyo, 157 Japan): *Trans. IECEJ*, vol. J69-C, pp. 1140–1147, Sept. 1986.

This paper describes the design of microwave power combiners, with open-coupled coaxial probes. To reduce the interference of the input ports, the combiners have sub-cavities and slits. The insertion loss of a 4-way and an 8-way combiner is 0.25 dB and 0.45 dB, respectively, at 12 GHz. A 40-W class FET amplifier has been developed using this 8-way combiner.

26

Circular to Rectangular Waveguide Mode Conversion through a Parabolic Cylinder Waveguide (TE_{0n} Incident), by O. Wada, and M. Nakajima (Faculty of Engineering, Kyoto University, Kyoto, 606 Japan): *Trans. IECEJ*, vol. J69-C, pp. 1266–1275, Oct. 1986.

Mode conversion is an oversized millimeter-wave waveguide is analyzed. A parabolic cylinder waveguide is inserted between a circular waveguide and a rectangular waveguide in order to transform circular TE_{0n} mode into linearly polarized modes. The mode conversion coefficient is calculated by the mode matching method. The result of calculation for the optimum length of the parabolic cylinder waveguide coincides with that obtained by the geometrical optics approximation.

27

Design of Low-Loss SAW Filters Employing Distributed Acoustic Reflection Transducers, by T. Kodama*, H. Kawabata*, Y. Yasuhara**, and H. Sato* (*Research and Development Center, Toshiba Corp. Kawasaki, 210 Japan; **Electron Tube and Device Group, Toshiba Corp., Kawasaki, 210 Japan): *Trans. IECEJ*, vol. J69-C, pp. 1297–1308, Oct. 1986.

A new structure of internal reflection type interdigital transducer is presented. It consists of many acoustic reflec-

tion elements distributed over the entire region of the transducer. An insertion loss less than 10 dB with spurious reflection levels less than −45 dB has been obtained.

28

The Approximate Relation between the Effective Dielectric Constant for a Microstripline and the Relative Dielectric Constant of the Substrate (Letters), by F. Kato, and S. Okamura (Faculty of Engineering, Shizuoka University, Hamamatsu, 432 Japan): *Trans. IECEJ*, vol. J69-C, pp. 1380–1382, Oct. 1986.

The effective dielectric constant for a microstripline is calculated by Callarotti's and Gallo's conformal transformations and the finite-element method. From the calculation, an approximate relation between the effective dielectric constant and the relative dielectric constant of the substrate has been obtained.

29

A Matching Circuit of a T-Shaped Ridge Waveguide Using Loaded Probes (Letters), by H. Arai and N. Goto (Faculty of Engineering, Tokyo Institute of Technology, Tokyo, 152 Japan): *Trans. IECEJ*, vol. E69, pp. 1167–1168, Nov. 1986.

A matching circuit between a ridged waveguide and a coaxialline by use of two loaded probes is discussed. Reflection coefficient with respect to the normalized impedance of 50 Ω is calculated with the impedance matrix of the equivalent circuit.

30

Transient Analysis of Microstrip Side-Coupled Filter in Three-Dimensional Space, by S. Koike, N. Yoshida, and I. Fukai (Faculty of Engineering, Hokkaido University, Sapporo, 060 Japan), vol. E69, pp. 1199–1205, Nov. 1986.

Characteristics of a microstrip side-coupled filter are analyzed by the three-dimensional space and time domain analysis using Bergeron's method. First the characteristic impedance and relative phase velocity of the lines are evaluated. Then the appearance of bandpass characteristics is shown by calculating the field distribution of Poynting vector.

31

A Low-Loss 6-Pole Canonical Dual-Mode Filter for the Output Multiplexer of Broadcasting Satellite Transponders in the 12 GHz Band, by T. Nomoto (NHK Science and Technical Research Laboratories, Tokyo, 157 Japan): *Trans. IECEJ*, vol. J69-B, pp. 1462–1469, Nov. 1986.

A filter for high-power broadcasting satellite transponders has been developed. This 6-pole canonical TE_{113} dual-mode filter, which is formed of silver-plated super invar, has an insertion loss of 0.3 dB at the center frequency and a thermal stability of 1.4 ppm/°C. No significant deterioration in the filter characteristics has been observed up to 200 W input power.

32

Analysis of Broadside-Coupled Suspended Striplines with Side-Wall Grooves, by B. Y. Wang, E. Yamashita, and K. Atsuki (Faculty of Engineering, The University of Electro-Communications, Chofu, 182 Japan): *Trans. IECEJ*, vol. J69-C, pp. 1397–1403, Nov. 1986.

This paper estimates effects of side wall grooves of broad-side coupled suspended strip lines on transmission characteristics. The analysis is based on the variational principle with the use of the first-order spline functions as the trial functions to express interface potentials.

33

Crosstalk of Coupled Transmission Lines with Round Wires for a Multiwire Circuit Board (Letters), by H. Shibata, and T. Koizumi (Department of Electrical Engineering, Ibaraki College of Technology, Katsuta, 312 Japan): *Trans. IECEJ*, vol. E69, pp. 1271–1274, Dec. 1986.

The analysis of crosstalk of wiring on a printed circuit is presented. In the analysis, the back crosstalk constant K_b is numerically obtained by the charge simulation method and quasi-TEM approximation. The behavior of K_b as a function of r/h (r: radius of wire; h: dielectric-layer thickness from ground plane) is obtained. The calculation approximately agrees with the experimental result.

34

Radiation Phenomenon from Transmission Lines of Finite Length, by Y. Kami*, and R. Sato** (*Junior Technical College of Electro-Communications, Chofu, 182 Japan; **Faculty of Engineering, Tohoku Gakuin University, Tagajo, 982 Japan): *Trans. IECEJ*, vol. J69-B, pp. 1820–1826, Dec. 1986.

An analysis of radiation from transmission lines of finite length is presented. Calculated radiation powers for two cases, straight and bended lines, are compared with experimental results. It is concluded that the radiation field is well predicted by this theory.

35

Fundamental Treatment of Anisotropic Medium by Bergeron's Method (Letters), by N. Kukutsu, T. Kashiwa, N. Yoshida, and Fukai (Faculty of Engineering, Hokkaido University, Sapporo, 060 Japan): *Trans. IECEJ*, vol. 69-C, pp. 1557–1559, 1986.

Magnetic anisotropic medium having only diagonal elements is analyzed by the Bergeron's method. The two types of the equivalent circuit are obtained by use of its duality in the circuits. It is shown that both equivalent circuits are appropriate for the analysis to the properties of the anisotropy.

36

Coupled Planar Helices (Letters), by M. P. Shinha (Advanced Centre of Research in Electronics, Indian Institute of Technology, Bombay 400 076 India): *JIETE* (India), vol. 32, pp. 38–41, Jan.–Feb. 1986.

Properties of a system of coupled planar helices are investigated. A set of transmission line equations are derived for the coupled system. From these transmission line equations, a dispersion relation is obtained. The computed results for the planar helix couplers indicate that its performance is comparable with that of circular helix couplers.

37

Coupling Between Asymmetric Microstrip Lines Through Apertures (Letters), by C. Chakraborty* and V. M. Pandharipande** (*Department of Electronics and Electrical Communication Engineering, IIT, Kharagpur 721 302 India; **Department of Electronics and Communication Engineering, University College of Engineering, Osmania University, Hyderabad 500 007 India): *JIETE* (India), vol. 32, pp. 41–43, Jan.–Feb. 1986.

An analysis of coupling between two microstriplines through small apertures (holes, thin slots) is presented. An equivalent parallel plate waveguide model supporting TEM wave is used. The formulation is based on Bethe's theory of coupling and takes the effective dielectric constant into account. The theoretical results obtained show a very good agreement with experimental data in both cases of hole and slot coupling.

38

Evanescent Mode Technique (Theory and Application), by D. K. Banerjee* and K. Schuenemann** (*Department of Electrical Engineering, Indian Institute of Technology, Madras 600 036 India; *Institute of High Frequency Techniques, Technical University, Braunschweig West Germany): *JIETE* (India), vol. 32, pp. 63–68, Mar.–Apr. 1986.

The theory of evanescent mode guide is explained. An equivalent circuit in *n*-configuration and an inverter in cutoff technique are derived. The elements of the equivalent circuit are given in terms of line constants and the practical values are calculated. Advantages and potential applications of this technique to realize high quality microwave components for FM and PCM communication systems are discussed.

39

On Development of Circulator in mm-Wave Region (Letters), by P. R. Rao (DLRL, Hyderabad, 500 005 India): *JIETE* (India), vol. 32, pp. 141–143, May–June 1986.

Ferrite circulators in the waveguide version are designed and developed in millimeter-wave region of frequencies in Ka and U bands. Equilateral triangular nickel ferrite prisms whose 4π Ms value is 5000 Gauss has been used. The characteristics of the circulator in both frequency bands are tabulated.

40

Cut-off and Bandwidth Characteristics of Inhomogeneous Rectangular Waveguide with Two Double Ridges, by P. K. Saha, and G. G. Mazumder (Institute of Radio Physics & Electronics 92, Acharya Prafulla Chandra Road, Calcutta 700 009 India): *JIETE* (India), vol. 32, pp. 377–382, Sept.–Oct. 1986.

The dispersion relation of the hybrid modes of a rectangular waveguide with two arbitrarily placed asymmetric double ridges and five gap and trough regions filled with dielectrics of different permittivities has been determined using Ritz-Galerkin technique. At cutoff, the general characteristic equation splits into two decoupled eigenvalue equations the solutions of which yield the H- and E-type cutoff wavelengths. Some typical numerical data on the cutoff wavelength and bandwidth of the dominant hybrid modes are presented.

41

Broadside-Coupled and Broadside Edge-Coupled Stripline-Like Transmission Lines with Anisotropic Substrates, by B. Bhat, and K. Koul (Centre for Applied Research in Electronics, Indian Institute of Technology, New Delhi 110 016 India): *JIETE* (India), vol. 32, pp. 389–397, Sept.–Oct. 1986.

A broadside-coupled symmetric strip transmission line embedded in a homogeneous anisotropic dielectric is analyzed using the spectral-domain technique under the quasi-static approximation. Comparison of the final capacitance formula with that of a corresponding isotropic structure derived using the two-wire transmission line analogy and identification of an admittance parameter lead to generalization of the capacitance expression for symmetric broadside-coupled lines. Numerical results are presented on the characteristic impedances and effective dielectric constants for some typical transmission structures.

42

Complementary Variational Formulation for a Class of 3-Dimensional Time Varying Electromagnetic Field Problems in Conducting Media (Letters), by V. A. Kumar*, Dattatreyan*, and D. Thangaraj** (*Department of Electrical Engineering, Indian Institute of Technology, Madras 600 036 India; **Dept. of Mathematics, Indian Institute of Technology Madras 600 36 India): *JIETE* (India), vol. 32, pp. 406–407, Sept.–Oct. 1986.

Complementary variational principles are applied to formulate time dependent electromagnetic field problems in conducting media. Upper and lower bounds are derived for the diffusion equation governing these problems.

3) Microwave Antennas

1

Investigation of a 30/20 GHz Band Antenna Radiation Characteristics in Snowing, by M. Kondo, S. Fukuda, and K. Kagoshima (NTT Electrical Communications Labs., Yokosuka, 238 Japan): *Trans. IECEJ*, vol. J69-B, pp. 78–87, Jan. 1986.

The loss and radiation pattern degradation due to snow adhesion on to the surfaces of the antenna and the radome are discussed. The snow adhesion distribution on the surfaces, and resulting loss increase, and the radiation

pattern have been measured through a whole winter season in a Japanese snowy region (Niigata). Theoretical study for those characteristics is also shown.

2

Unified Analysis of Ridge-Waveguide Slot Antenna in 3-Dimensional Space and Time, by T. Kashiwa, N. Yoshida, and I. Fukai (Faculty of Engineering, Hokkaido University, Sapporo, 060 Japan): *Trans. IECEJ*, vol. J69-B, pp. 171–178, Feb. 1986.

A T-ridge waveguide slot antenna for fusion plasma heating is proposed. The time response of the electromagnetic field in the three dimensional space, involving the T-ridge waveguide, the slots, and the external heating space with dielectric medium, is analyzed by Bergeron's method. The instantaneous diagrams of the pointing vector showing the heating characteristics have been obtained.

3

Numerical Analysis of Diffraction from a Sinusoidal Metal Grating, by K. Yasuura*, and M. Murayama** (*Faculty of Engineering, Kyushu University, Fukuoka, 812 Japan; **Interdisciplinary Graduate School of Engineering Sciences, Kyushu University, Fukuoka, 812 Japan): *Trans. IECEJ*, vol. J69-B, pp. 198–205, Feb. 1986.

Diffraction of electromagnetic plane waves by a metal grating of a sinusoidal cross section is theoretically investigated by taking into consideration a finite conductivity of the material. The analysis is based on the mode-matching method with a smoothing procedure. The results are compared with those obtained for a perfectly conducting grating of the same cross section. The effect of a finite conductivity on the diffraction characteristics is discussed.

4

Radiation Characteristics of Reflector Antenna with Radome at 10–30 GHz in Rainy Condition, by M. Kondo*, S. Fukuda**, and K. Kagoshima** (*Telecommunications Satellite Corp. of Japan, Kimitsu, 292-06 Japan; **NTT Electrical Communications Labs., Yokosuka, 238 Japan): *Trans. IECEJ*, vol. J69-B, pp. 265–273, Mar. 1986.

This paper describes measured results of the radome loss and radiation pattern of a Cassegrain antenna with a plane radome for different rainfall conditions. It is shown that the contact angle of rain drops on the radome is a key parameter which determines the radome loss. Calculation method for the distribution of rain drops adhesion on the radome and for radome loss is proposed.

5

Design of a Low-Loss Grating on a Dielectric Sheet (Letters), by M. Murota, M. Ando, and N. Goto (Faculty of Engineering, Tokyo Institute of Technology, Tokyo, 152 Japan): *Trans. IECEJ*, vol. E69, pp. 321–322, Apr. 1986.

A low-loss polarization-selective grating with a symmetrical double structure is proposed for wider frequency band use. The grating is composed of two grids placed parallel with a quarter-wavelength spacing. Each grid is made on a dielectric sheet. Theoretical transmission loss is smaller than 0.025 dB in the frequency band of $0.655 < f/f_0 < 1.185$ which is twice as wide as previously reported ones.

6

Analysis of a Half-Wave Dipole Antenna above a Two-Layered Earth, by K. Nakagawa, (Wakayama College of Technology, Gobo, 644 Japan): *Trans. IECEJ*, vol. J69-B, pp. 379–387, Apr. 1986.

The integral expression of the field excited by a vertical wire antenna and a horizontal one located in the free space near above the two-layered earth is derived by the method of an equivalent circuit in multi-layered medium. The integral equation based upon the current distribution is solved by the direct method and the moment method. The input impedance and directive pattern are shown.

7

Analysis of Mobile Antenna in UHF Band, by K. Nishikawa, and Y. Asano (Toyota Central Research & Development Laboratories, Inc., Aichi, 480-11 Japan): *Trans. IECEJ*, vol. J69-B, pp. 388–396, Apr. 1986.

Theoretical and experimental studies are made on an antenna mounted on an automobile's roof. The input impedance and vertical plane patterns of a quarter wavelength monopole in the 300–900-MHz band are calculated with a model of an automobile body. The model consists of three perfectly conducting plates. The results of pattern calculation show that the radiation patterns depend largely on the configuration of the automobile body.

8

Analysis of Sleeve Antenna with Ground Wires, by M. Taguchi, S. Egashira, and T. Ohzono (Faculty of Science and Engineering, Saga University, Saga, 840 Japan): *Trans. IECEJ*, vol. J69-B, pp. 520–527, May 1986.

Analysis and experiment on a sleeve antenna are presented. For improving the impedance matching between the antenna and the feeder, the ground wires are attached on the sleeve. When the sleeve of 0.2λ long and ground wires of 0.1λ long are attached, an input impedance of 50Ω and a directive gain of 2.1 dB have been obtained.

9

An Array Fed Multibeam Antenna Using Equal Phase-Shift Active Elements, by S. Egami, and M. Kawai (NTT Electrical Communications Labs., Yokosuka, 238 Japan): *Trans. IECEJ*, vol. J69-B, pp. 528–534, May 1986.

An array-fed multibeam antenna suitable for multicarrier multibeam satellite communications is proposed. The array consists of active elements fed by multibeam feed horns and radiates spherical waves to the reflector. An S-band configuration and calculated radiation pattern are shown. Experiments using a 19-element passive array are carried out.

10

Low Profile Primary Radiator Composed of Shaped-Beam Array Having Microstrip Paired-Element (Letters), by M. Haneishi*, S. Saito*, and N. Goto** (*Faculty of Engineering, Saitama University, Urawa, 338 Japan; **Faculty of Engineering, Tokyo Institute of Technology, Tokyo, 152 Japan): *Trans. IECEJ*, vol. J69-B, pp. 571–572, May 1986.

A new type of low-profile primary radiator having microstrip elements has been constructed and tested. Design techniques and experimental results are presented.

11

Loop Antenna with a Branch Wire for Circular Polarization, by T. Nakamura and S. Yokokawa (Faculty of Engineering, Gifu University, Gifu, 501-11 Japan): *Trans. IECEJ*, vol. J69-B, pp. 624–630, June 1986.

A loop antenna with a branch wire for circular polarization is described. An equivalent circuit for expressing the effect of the branch wire on balanced and unbalanced modes is derived. A fabricated antenna acts as the dual-feed loop antenna without requiring a power divider or a phase sifter to produce a circularly polarized radiator.

12

Transient Analysis of Cutoff Waveguide Antenna in Three-Dimensional Space, by T. Kashiwa, N. Yoshida, and I. Fukai (Faculty of Engineering, Hokkaido University, Sapporo, 060 Japan): *Trans. IECEJ*, vol. J69-B, pp. 732–740, July 1986.

The time response of the electromagnetic field in the three dimensional space, involving the cutoff waveguide, the coaxial exciter, and the external heating space with dielectric medium is analyzed by Bergeron's method. The instantaneous diagrams of the pointing vector show the fundamental heating characteristic of this type of exciter. Distinct difference has been observed in the fields with and without the dielectric.

13

Mutual Coupling between Dipole Antennas Located over a Conducting Concave Spherical Surface (Letters), by T. Maeda*, K. Sawaya*, S. Adachi*, and Y. Mushiake** (*Faculty of Engineering, Tohoku University, Sendai, 980 Japan; **Tohoku Institute of Technology, Sendai, 980 Japan): *Trans. IECEJ*, vol. J69-B, p. 741–742, July 1986.

Mutual coupling between two dipole antennas located on a conducting concave spherical surface is analyzed by using the field expression in terms of the whispering gallery modes and continuous spectrum. Numerical calculation shows that the mutual coupling is considerably small compared with that for slot antennas.

14

Characteristics of Antenna Pattern Diversity Branches in Urban Mobile Radio, by F. Ikegami, T. Takeuchi, and S. Yoshida (Faculty of Engineering, Kyoto University, Kyoto, 606 Japan): *Trans. IECEJ*, vol. J69-B, pp. 823–832, Aug. 1986.

This paper discusses the principle of antenna pattern diversity (APD) reception, and describes the experimental results of the correlation characteristics of APD branches. Sufficiently small correlation coefficient is observed in case of four APD branches, compared with space diversity branches with omnidirectional antennas. Computer simulation shows that large fading improvement is achieved with a four-branch APD reception.

15

On the Numerical Analysis of the Microstrip Printed Dipoles, by M. Kominami, and K. Rokushima (Faculty of Engineering, University of Osaka Prefecture, Sakai, 591 Japan) *Trans. IECEJ*, vol. J69-B, pp. 941–948, Sept. 1986.

A printed dipole on a grounded substrate is investigated. The solution is based on the moment method in Fourier transform domain. A generalized impedance matrix has been obtained as a quickly converging integral of a closed-form equation. By using the present formulation, the input impedance and radiation efficiency are calculated. Comparison with experiment shows an excellent agreement.

16

Analysis of Two Parallel Nonstaggered Vertical Dipole Antennas above a Lossy Ground, by K. Nakagawa (Wakayama College of Technology, Gobo, 644 Japan): *Trans. IECEJ*, vol. J69-B, pp. 976–983, Sept. 1986.

The integral equation for two-parallel nonstaggered vertical wire antennas above a lossy half-space is solved by two methods, rigorous direct integral approach and reflection coefficient approximation. The results for two methods are compared.

17

Beam-Shaping of Microstrip Antennas by Parasitic Elements having Tunable Stub (Letters), by M. Haneishi, and H. Suga (Faculty of Engineering, Saitama University, Urawa, 338 Japan): *Trans. IECEJ*, vol. J69-B, pp. 1160–1161, Oct. 1986.

Beam-shaping microstrip antennas composed of feeding and parasitic elements have been constructed and tested. Design techniques and experimental results are presented.

18

A Low-Profile Dual-Band Microstrip Antenna Having Open-Circuited Stripline-Stub (Letters), by M. Haneishi, H. Suga, and T. Hasegawa (Faculty of Engineering, Saitama University, Urawa, 338 Japan), vol. E69, pp. 1165–1166, Nov. 1986.

A new type dual-band microstrip antenna, in which a conformal open-circuited stripline stub is mounted on a plane, is presented. Design of the antenna and obtained patterns are described.

19

Reflection and Transmission Coefficients of a Thin Grating on a Dielectric Sheet, by M. Ando and M. Murota (Facility of Engineering, Tokyo Institute of Technology, Tokyo, 152 Japan): *Trans. IECEJ*, vol. E69, pp. 1189–1198, Nov. 1986.

Simple and closed form expressions for reflection and transmission coefficients of a thin strip grating on a dielectric sheet are presented for the use of antenna application. In the analysis, a set of integral equations for the aperture fields are derived from the three dimensional boundary value problem. The accuracy of the approximation is numerically discussed by making use of the point matching method.

20

Multi-Beam Antennas for Satellite Use, by T. Itanami, K. Ueno, M. Nisawa, M. Minomo, and I. Ohtomo (NTT Electrical Communications Labs., Yokosuka, 238 Japan): *Trans. IECEJ*, vol. J69-B, pp. 1422–1429, Nov. 1986.

This paper describes design and measured characteristics of on-board K-band (30/20 GHz) and S-band (2.6/2.5 GHz) multi-beam antennas. The K-band antenna, which covers Japan with 4 beams, has a diameter of 1.3 meters and simultaneously uses two orthogonally polarized waves. The radiation pattern of the S-band antenna covers an area within 200 nautical miles around Japan mainland. The S-band reflector with a diameter of 3.5 meters is made of fan-rib type deployable mesh.

21

Low-Sidelobe Multibeam Antenna Fed by Cluster Horns, by Y. Yamada, K. Kagoshima, and T. Kobayashi (NTT Electrical Communications Labs., Yokosuka, 238 Japan): *Trans. IECEJ*, vol. J69-B, pp. 1430–1440, Nov. 1986.

The design and low-sidelobe performance of cluster-fed multibeam antennas are presented. The horn size and the antenna diameter suitable to low-sidelobe synthesis are derived from a simplified model. The optimum cluster excitation coefficients, aperture distribution, and limit of sidelobe levels are then examined for on-focus feed.

22

Beam Scanning Characteristics of Front Fed Offset Cassegrain Type Multibeam Antenna, by S. Makino, Y. Kobayashi, S. Urasaki, and T. Katagi (Mitsubishi Electric Corporation, Kamakura, 247 Japan): *Trans. IECEJ*, vol. J69-B, pp. 1453–1461, Nov. 1986.

This paper shows that front fed offset Cassegrain (FFOC) antennas are suitable for multibeam antennas for international communications satellite applications. First, problems of the conventional reflector system are pointed out. Then the beam scanning characteristics of FFOC type multibeam antennas are theoretically shown and are experimentally confirmed. The measured gain reduction and cross polarization level of the experimental model with a 120-wavelength aperture diameter are less than 1.8 dB and -34 dB respectively.

23

30 GHz Band RF Sensor for Satellite Antenna, by K. Ueno and T. Kaitsuka (NTT Electrical Communications Labs., Yokosuka, 238 Japan): *Trans. IECEJ*, vol. J69-B, pp. 1495–1503, Nov. 1986.

This paper describes the design and performance of a 30-GHz band RF sensor consisting of a five-horn monopulse feed and a tracking receiver. The aperture diameter is 1.3 m. It has been found that the sensor accuracy is about 1/50 of the half-power beamwidth of the antenna, and that the sensor accuracy normalized by the half-power beamwidth does not depend upon antenna diameter.

24

A Comparison of Calculation Method in Pattern Analysis of Rotationally Symmetric Reflector Antennas, by M. Ando and M. Furuya (Faculty of Engineering, Tokyo Institute of Technology, Tokyo, 152 Japan): *Trans. IECEJ*, vol. J69-B, pp. 1795–1803, Dec. 1986.

For radiation pattern analysis of rotationally symmetric reflector antennas, two methods, physical optics (PO) and geometical theory of diffraction (GTD) are compared and discussed. Maximum and minimum observation angles are expressed as functions of antenna parameters (diameter, edge illumination level, and angular aperture).

25

An Investigation of Radio Wave Intensity Distribution in the Automobile Body, by M. Tanaka, and Y. Miyazaki (Department of Information and Computer Science, Toyohashi University of Technology, Toyohashi, 440 Japan): *Trans. IECEJ*, vol. J69-B, pp. 1804–1810, Dec. 1986.

To design antennas which is mounted inside cars, a simulation experiment has been carried out. In the simulation, a miniaturized car of 1/15 in size and 4 GHz are used. It has been found that the modes of the field are TE_{1m0} and TE_{1m1}. The optimum position of antenna elements is discussed.

26

Antenna Design Principles for Satellite Communications, by T. S. Bird, G. L. James, G. T. Poulton, and B. Mac. A. Thomas (CSIRO Division of Radio Physics, PO Box 76, Epping, NSW 2121 Australia); *JEEE* (Australia), vol. 6, pp. 6–13, Mar. 1986.

The antenna configurations used for both earth stations and satellites in Australia are described. The specifications to antennas used for satellite communications and their effects on the design of the antennas are considered. Examples of both earth-station and satellite antennas and their characteristics are illustrated by reference to the INTELSAT and AUSSAT networks. Future trends in earth-station and satellite antenna design are also considered.

27

Antennas for Satellite Communications (Some Highlights in Past Development and Future Trends), by T. B. Vu (University of N.S.W., PO Box 1 Kensington, NSW 2033 Australia): *JEEE* (Australia), vol. 6, pp. 226–233, Sept. 1986.

A review of antenna development for satellite communications is presented. Antenna development prior to satellite communications, and modern antennas for commercial purpose are described. Some challenging problems facing past and future designers of ground-based and space-borne antennas for satellite communications are then discussed.

4) Microwave Propagation and Scattering

1

Scattering of Hermite-Gaussian Beams by Parallel Conducting Cylinders, by M. Yokata, T. Takenaka, and O. Fukumitsu (Faculty of Engineering, Kyushu University, Fukuoka, 812 Japan): *Trans. IECEJ*, vol. J69-B, pp. 71–77, Jan. 1986.

Scattering of Hermite-Gaussian beams by an arbitrary configuration of parallel perfectly conducting cylinders is investigated. The beam modes are expressed by a superposition of multipole fields with complex source points in the paraaxial region. The scattering field is then given by a superposition of the multipole fields. The scattering patterns are examined for a Gaussian beam incident on an array of eight cylinders with the first Bragg angle.

2

A Simplified Fading Reduction Technique in Maritime Satellite Communications (Letters), by M. Yasunaga, Y. Karasawa, and T. Shiokawa (Research and Development Laboratories, Kokusai Denshin Denwa Co, Ltd., Tokyo, 153 Japan): *Trans. IECEJ*, vol. E69, pp. 83–85, Feb. 1986.

A simple fading reduction method by use of polarization shaping and beam offset is proposed. Since this method employs a fixed phase shifter and small antenna structure, the operation is simple and accurate fading reduction is obtained.

3

On-board Experiments on L-band Multipath Fading and Its Reduction by Use of the Polarization Shaping Method, by Y. Karasawa, M. Yasunaga, S. Nomoto, and T. Shiokawa (Research and Development Laboratories, Kokusai Denshin Denwa Co., Ltd., Tokyo, 153 Japan): *Trans. IECEJ*, vol. E69, pp. 124–131, Feb. 1986.

On-board experiments of multipath fading with low elevation angles have been carried out at 1.5 GHz. This paper shows the outline of the experiments, evaluation of fading reduction, and comparison with the theory previously presented by the authors.

4

Numerical Analysis of Plane Wave Scattering by an Infinite Plane Grating Using Weighted Fourier Series, by K. Uchida, T. Noda, and T. Matsunaga (Faculty of Engineering, Fukuoka Institute of Technology, Fukuoka, 811-02 Japan): *Trans. IECEJ*, vol. E69, pp. 132–138, Feb. 1986.

This paper presents a numerical analysis for the plane wave scattering by an infinite plane grating. The induced surface currents on conducting strips are expanded in Fourier series with a weighting function corresponding to field singularities near edges of the strips. It shows that the final numerical solutions rapidly converge for the near fields as well as for the far fields. From comparison of the present method with conventional method, it is found that the present method gives precise solutions for the transmitted power.

5

Modification of Morita and Higuchi's Prediction Method of Lognormal Rain Attenuation Distribution by Using Spatial Correlation of Specific Attenuation, by T. Ihara, Y. Furuhama, and T. Manabe (Radio Research Laboratory, Ministry of Posts and Telecommunications, Koganei, 184 Japan): *Trans. IECEJ*, vol. E69, pp. 139–147, Feb. 1986.

In Morita and Higuchi attenuation prediction method, the spatial correlation function, ρ_Γ, of specific attenuation is approximated by ρ (the spatial correlation function of rainfall rate). Theoretical and experimental examination shows that the approximation $\rho_\Gamma = \rho$ is not accurate in the frequency range 10 to 100 GHz, except for frequencies near 30 GHz. A modified method in which attenuation is expressed by ρ_Γ is proposed.

6

Suppression of Ground Clutter Using an X-Band Radar, by T. Iwama, M. Sekine, and T. Musha (The Graduate School at Nagatsuta, Tokyo Institute of Technology, Yokohama, 227 Japan), *Trans. IECEJ*, vol. J69-B, pp. 256–264, Mar. 1986.

In the design of radar system, it is important to suppress various clutters which are caused by unwanted reflected waves from irrelevant targets. It is known that the clutter amplitudes obey Weibull distribution. In this paper, a 40-nsec high speed sampling device of an X-band radar and ground clutter measurement with this radar are shown. It is shown that the amplitudes of land-surface and the buildings obey a combined-Weibull distribution.

7

Study on Radiometric Quality of Synthetic Aperture Radar Imagery (Letters), by H. Hirosawa (Institute of Space and Astronautical Science, Tokyo, 153 Japan): *Trans. IECEJ*, vol. J69-B, pp. 292–294, Mar. 1986.

This letter discusses relationship between the radiometric qualities of synthetic aperture radar imagery, and the noise-equivalent scattering coefficient of a radar system. The number of quantization bits of receiver output signals is also discussed.

8

Analysis of Electromagnetic Fields in a Domain with Plane Open Boundaries (Letters), by Y. Hayashi (College of

Science and Technology, Nihon University, Funabashi, 274 Japan): *Trans. IECEJ*, vol. E69, pp. 311–313, Apr. 1986.

This letter presents a general analysis of the electromagnetic fields in a domain which includes multiple metallic planes placed parallel to each other. The analysis is based upon the fact that the problem of parallel metallic plane boundaries can be reduced to the scalar boundary value problem with respect to three-dimensional Helmholtz equation.

9

Analysis of the Plane Wave Scattering from a Dielectric Cylinder by Means of the Charge Simulation Method (Letters), by A. Komiyama (Faculty of Engineering, Meji University, Kawasaki, 214 Japan): *Trans. IECEJ*, vol. E69, pp. 314–316, Apr. 1986.

An analysis of the E-type plane wave scattering by a dielectric cylinder based on the charge simulation method is given. It shows that the accuracy of the approximate solution depends on the location of its singularities the same as the case of the perfectly conducting cylinder.

10

Scattering of a Three-Dimensional Hermite-Gaussian Beam Mode by a Dielectric Circular Cylinder (Letters), by M. Yokota, T. Takenaka, and O. Fukumitsu (Faculty of Engineering, Kyushu University, Fukuoka, 812 Japan): *Trans. IECEJ*, vol. E69, pp. 317–320, Apr. 1986.

Scattering of a three-dimensional Hermite-Gaussian beam mode by a dielectric circular cylinder at normal incidence is considered. The analysis is done by the complex-source-point method. The scattered fields are numerically examined for the lowest-order mode.

11

An Analytical Approach of Wave Problem in Periodically to Randomly Distributed Scatterers (Letters), by M. Tateiba (Faculty of Engineering, Kushu University, Fukuoka, 812 Japan): *Trans. IECEJ*, vol. E69, pp. 323–325, Apr. 1986.

The problem of wave scattering by randomly distributed scatterers is analyzed by multiple scattering theory.

12

Rain Attenuation from Various Raindrop-Size Distributions (Letters), by M. Sekine, and C. D. Chen (Graduate School at Nagatsuta, Tokyo Institute of Technology, Yokohama, 227 Japan): *Trans. IECEJ*, vol. E69, pp. 711–712, June 1986.

The rain attenuation in the frequency range from 1 to 1000 GHz is calculated by using Laws-Parsons, Sekine-Lind and Ihara-Furuhama-Manabe raindrop-size distributions. Laws-Parsons distribution has a good agreement with the measurements. Above 100 GHz, Ihara-Furuhama-Manabe and Sekine-Lind distributions give more attenuation than Laws-Parsons distribution.

13

Electromagnetic Scattering by Perfectly Conducting Rectangular Cylinders, by K. Motojima, T. Kobayashi, and S. Kozaki, (Faculty of Engineering, Gunma University, Kiryu, 376 Japan): *Trans. IECEJ*, vol. J69-B, pp. 631–639, June 1986.

Scattering of plane wave by a row of N perfectly conducting rectangular cylinders is analyzed by the point matching method. The multiple scattering of each rectangular cylinder is considered in this method. The scattered field pattern in the vicinity of rectangular cylinders are also presented.

14

Path Visibility and Reflected Wave Propagation Characteristics in Built-up Areas, by E. Ogawa, and A Satoh (NTT Electrical Communications Labs., Yokosuka, 238 Japan): *Trans. IECEJ*, vol. J69-B, pp. 958–966, Sept. 1986.

Radio local distribution systems provide direct connection between a nodal station and surrounding subscribers. This paper discusses the path visibility and reflected wave propagation characteristics based on the building distributions in practical city areas. A method for calculating the number of arriving reflected waves is proposed.

15

Characteristics of L-band Multipath Fading due to Sea Surface Reflection in Aeronautical Satellite Communications (Letters), by M. Yasunaga, Y. Karasawa, T. Shiokawa, and M. Yamada (Research and Development Laboratories, Kokusai Denshin Denwa Co., Ltd., Tokyo, 153 Japan): *Trans. IECEJ*, vol. E69, pp. 1060–1063, Oct. 1986.

This paper theoretically discusses fading depth, spectrum of fading depth, and correlation of reflected waves in space and frequency domain of multipath fading in aeronautical satellite communications.

16

Scattering of Electromagnetic Plane Waves by Arbitrarily Oriented Two Parallel Conducting Strips, by M. Nishimoto, and K. Aoki (Faculty of Engineering, Kyushu University, Fukuoka, 812 Japan): *Trans. IECEJ*, vol. J69-B, pp. 1131–1139, Oct. 1986.

Scattering problem of electromagnetic plane waves by arbitrarily oriented two parallel conducting strips is analyzed by using modal expansion and Galerkin's method. Accurate solutions are obtained by modal functions satisfying the edge condition. Scattered far field patterns, backscattering cross sections and near fields are shown for several configurations.

17

Scattering of Plane Electromagnetic Wave by a Semi-Infinite Strip Grating (Letters), by M. Nishimoto, and K. Aoki (Faculty of Engineering, Kyushu University, Fukuoka, 812 Japan): *Trans. IECEJ*, vol. E69, pp. 1161–1164, Nov. 1986.

In the analysis, the width of strips is assumed to be narrow compared with the wavelength. The current induced on each strip is expressed by a sum of the currents on infinite strip gratings and a correction current. The current is determined by solving the integral equation of two-dimensional Green's function.

18

Finite-Element Analysis of Plane Wave Diffraction from Dielectric Gratings, by Y. Nakata, M. Koshiba, and M. Suzuki (Faculty of Engineering, Hokkaido University, Sapporo, 060 Japan): *Trans. IECEJ*, vol. J69-C, pp. 1503–1511, Dec. 1986.

A numerical analysis for solving the diffraction problem of dielectric gratings of arbitrary shape is proposed. The analysis is based on the finite-element method, and both cases of TE and TM wave incidences are treated. The validity of the method is discussed for rectangular, sinusoidal, and trapezoidal dielectric gratings.

19

The Relationship between Radar Reflectivity and Rainfall Rate (Letters), by M. Sekine (Department of Applied Electronics, Tokyo Institute of Technology, Yokohama, 227 Japan): *Trans. IECEJ*, vol. E69, pp. 581–582, May 1986.

The relationship between the radar reflectivity factor Z and the rainfall rate R is analyzed using a new raindrop-size distribution. The raindrop-size distribution has an improved fit to the existing empirical data. A relation, $Z = 286R^{1.6}$, has been obtained. Whereas, $Z = 200R^{1.6}$ is frequently assumed in radar meteorology.

20

A Method of Predicting the Desired-to-Undesired Power Ratio in Rain Scatter Interference, by J. Awaka (Radio Research Laboratory, Koganei, 184 Japan): *Trans. IECEJ*, vol. E69, pp. 645–650, May 1986.

This paper proposes a method of predicting the cumulative distribution of the desired-to-undesired power ratio from the cumulative distribution of rain rate. It is assumed that the rain rate and the rain attenuation obey the log-normal distribution. The predicted values show a good agreement with the experimental values obtained in a 14.3-GHz rain scatter experiment.

21

In-Phase Synthetic Method for the Measurement of Reflection Characteristics of Materials by Means of UHF TV Broadcasting Wave, by N. Hasebe*, F. Shimizu**, H. Kobayashi***, and K. Saegusa* (*College of Science and Technology, Nihon University, Funabashi, 274 Japan; **NEC Corporation, Yokohama, 226 Japan; ***Matsushita Communication Industrial Co., Ltd., Yokohama, 223 Japan): *Trans. IECEJ*, vol. J69-B, pp. 560–568, May 1986.

A new method for measuring reflection characteristics of materials is presented. The principle of the measurement is based on the focused synthetic aperture radar technique. By applying the phase focusing process on linearly moving sample, the true reflected wave from the sample is emphasized, while multipath reflected waves are suppressed. Reflection characteristics have been measured, utilizing a UHF TV broadcasting wave.

22

Characteristics of Radiowaves at VHF/UHF for Mobile Communication in Suburban Areas (Letters), by V. Kumar, R. K. Tewari, and B. S. Jassal (Defence Electronics Applications Laboratory, Dehra Dun 248 001 India): *JIETE* (India), vol. 32, pp. 33–36, Jan.–Feb. 1986.

Propagation measurements have been carried out at 52.5, 157, 298, 455, and 800 MHz in plains of Northern India and Assam. The dependence of median field strength on distance, frequency and antenna height is investigated. The results have been compared with the prediction curves given by CCIR with a conclusion that the CCIR curves can be used for Northern plains but they give an underestimation of field strength for Assam plains of India.

23

Control of Radar Cross Section by Impedance Loading. Test done by Image Plane in the X-Band (Letters), by D. Guha and V. S. Rawat (Department of Electronics and Communication Engineering, University of Roorkee, Roorkee 247 667 India): *JIETE* (India), vol. 32, pp. 36–38, Jan.–Feb. 1986.

The effect of reactive loading on the radar cross section of a metallic sphere has been investigated. The measurements are done in the X-band. The perturbation, or the reactive loading is made by means of thin slots cut through the whole surface of the spheres are different angles to the plane of illumination. The comparison of loaded to unloaded spheres confirms the control by reactive loading.

24

Turbulence Characteristics from Microwave Amplitude Scintillations (Letters), by D. N. Rao*, M. J. Kesavamurthy*, S. K. Sarkar**, H. N. Dutta**, B. M. Reddy** (*Department of Physics, S. V. University, Tirupati 511 502 India; **Radio Science Division, National Physical Laboratory, New Delhi 110 102 India): *JIETE* (India), vol. 32, pp. 80–83, Mar.–Apr. 1986.

Microwave amplitude variations were monitored on twenty four hour basis during March 1981 to April 1983 using Tiruttani-Tirupati communication link situated in Southern India. The probability of scintillation index shows that at 10% level, scintillation index is 25% for post-monsoon, 35% for winter, 90% for premonsoon and 15% for monsoon.

25

Experimental Studies on the Rain Attenuation Characteristics of Centimetre Waves, by R. K. Tewari, K. S. Kumar, and V. C. Bahuguna (Defence Electronics Applications

Laboratory, Dehra Dun 248 001 India): *JIETE* (India), vol. 32, pp. 130–135, May–June 1986.

Experimental studies have been carried out on the rain attenuation characteristics of radiowaves in and around Dehra Dun by establishing short distance experimental links at 11 and 17 GHz. Results obtained in this experiment and comparison with those obtained so far are presented. A method is also proposed to evaluate the attenuation statistics from point rain rate statistics.

26

Exotic Propagation of TV Signals across the India Sub-Continent, by P. K. Rangale, N. K. Swami, and B. Singh (CEERI, Pilani, 333 031 India): *JIETE* (India), vol. 32, pp. 143–145, May–June 1986.

Indian sub-continent presents anomalous propagation of TV signals in the near and far-off distances. The paper presents consolidated thinking on the subject and results of experiments carried out over past years.

5) Microwave Medical/Biological Applications

1

Both E- and H-Plane Converging Applicator for Deep and Localized Microwave Hyperthermia, by Y. Nikawa*, T. Katsumata*, M. Kikuchi**, and S. Mori* (*Faculty of Science and Technology, Keio University, Yokohama, 223 Japan; **Department of Medical Engineering, National Defence Medical College, Tokorozawa, 359 Japan): *Trans. IECEJ*, vol. J69-B, pp. 88–95, Jan. 1986.

A new applicator for deep and localized hyperthermia has been developed. In the applicator the electromagnetic field is converged in both the magnetic and electric planes. The reaching depth of this applicator is more than twice that of the rectangular waveguide applicator. Typically, the depth is 30 mm for 2450 MHz.

2

Calculation of Thermal Stress Inside Human Head by Pulsed Microwave Irradiation (Letters), by T. Shibata, O. Fujiwara, K. Katoh, and T. Azakami (Faculty of Engineering, Nagoya Institute of Technology, Nagoya, 464 Japan): *Trans. IECEJ*, vol. J69-B, pp. 1144–1146, Oct. 1986.

For investigating the hazard of pulsed microwave radiation, this paper analyzes the thermal stress inside a human head in which a hot spot with surface heating appears. From the analysis, the influence of the surface heating on the thermal stress is examined.

6) Lasers and Other Devices

1

1.55 μm GaInAsP/InP Buried Heterostructure Lasers with Multiple p-n Current Blocking Layer Entirely Grown by Low-Pressure OMVPE (Letters), by M. Nagashima, Y. Miyamoto, C. Watanabe, Y. Suematsu, and K. Furuya (Department of Physical Electronics Tokyo Institute of Technology, Tokyo, 152 Japan): *Trans. IECEJ*, vol. E69, pp. 92–94, Feb. 1986.

GaInAsP/InP BH lasers with multiple p-n current blocking layer have been fabricated for 1.55-μm operation by low-pressure OMVPE (organo-metallic vapor-phase epitaxy). The undercut portions are filled in a manner similar to mass transport process. The laser shows a threshold current of 48 mA at 300 K under CW operation.

2

100 Mb/s Monolithic Integrated Optical Transmitter Using a 1.3 μm LED, by K. Yamashita*, Y. Takasaki*, M. Maeda*, T. Kaji**, and N. Maeda*** (*Central Research Lab., Hitachi Ltd., Kokubunji, 185 Japan; **Device Development Center, Hitachi Ltd., Kodaira, 187 Japan; ***Fiber Optics Project Division, Hitachi Ltd., Yokohama, 244 Japan): *Trans. IECEJ*, vol. J69-B, pp. 46–53, Jan. 1986.

A 100-Mb/s monolithic integrated optical transmitter using a 1.3-μm-wavelength LED has been developed. The response timer for modulation/demodulation and the stability of output power has been improved. A switching speed of 1.5 ns and a ± 0.4-dB output fluctuation in a temperature range 0–50°C and in a supply voltage range $5V \pm 5\%$ have been obtained.

3

Solid Thin Film Energy Transfer Dye Lasers, by S. Muto, F. Shiba, Y. Iijima, K. Hattori, and C. Ito (Faculty of Engineering, Yamanashi University, Kofu, 400 Japan): *Trans. IECEJ*, vol. J69-C, pp. 25–32, Jan. 1986.

The efficiency and oscillation bandwidth of thin-film energy-transfer dye lasers (ETDLs) are discussed. It is shown that when several donor-acceptor dye pairs doped in the polymer waveguide are pumped by a pulsed N_2 laser, the efficient ETDL operation is obtained, and that these thin film ETDLs can cover a wide spectral region from near ultraviolet to near infrared.

4

Theoretical Investigation for Coupling between a Laser Diode and an Optical Waveguide via a Gap, by Y. Fujii, M. Matsuhara, and N. Kumagai (Faculty of Engineering, Osaka University, Suita, 565 Japan): *Trans. IECEJ*, vol. J69-C, pp. 33–40, Jan. 1986.

Butt coupling between a laser diode and an optical waveguide is theoretically analyzed by the boundary element method and eigenmode expansion method. From the analysis, it is confirmed that a double-layered anti-reflector film applied on the waveguide facet is effective to reduce the external optical feedback that severely affects the operation of the single longitudinal mode lasers. This method of analysis is also applicable to the case where the gap consists of several dielectric media.

5

Analysis of Semiconductor Multilayer and Its Application to Surface Emitting Lasers, By M. Norinaga, A. Chailertvanitkul, and K. Iga (Research Laboratory of Precision Machinery and Electronics, Tokyo Institute of Technol-

ogy, Yokohama, 227 Japan): *Trans. IECEJ*, vol. J69-C, pp. 59–65, Jan. 1986.

A design consideration has been made for a surface emitting 1.5-μm GaInAsP/InP laser with a distributed Bragg reflector (DBR). The employed DBR is made of multiple quarter-wavelength layers of semiconductors which have wider bandgaps than the active layer. Complex field reflectivity of the DBR is analytically obtained by modifying the matrix theory. It incorporates a loss of the medium, since the free carrier absorption loss inherently exists in semiconductors. The intensity reflectivity and phase shift of the DBR are calculated.

6

A Rotating Linearly Polarized Light Source and Its Applications for Optical Measurements, by H. Takahashi, C. Masuda, T. Koide, and K. Miyaji (Department of Electronics Engineering, Shibaura Institute of Technology, Tokyo, 108 Japan), vol. E69, pp. 157–162, Feb. 1986.

The apparatus of a rotating linearly polarized light source has been constructed using an acousto-optic tunable filter (AOTF) employing a TeO_2 crystal. The characteristics of optical devices, such as birefringence of optical fiber, and film thickness and refractive index of optical thin-film are measured using this apparatus.

7

Electro-Optic Effect in Zincblende Crystals (Letters), by S. Ohke*, Y. Cho**, and T. Okabe* (*Faculty of Engineering, Daido Institute of Technology, Nagoya, 457 Japan; **The Institute of Scientific and Industrial Research, Osaka University, Ibaraki, 567 Japan), vol. J69-C, pp. 224–226, Feb. 1986.

Electro-optic effect of zincblende crystals, to which the electric field is applied in arbitrary directions, is analyzed by the eigenvalue equation led from the index ellipsoid equation. The obtained results are summarized in a table.

8

Reflection Noise Measurement of Dynamic Single Mode Lasers (Letters), by H. Fukui, Y. Suematsu, K. Furuya, Y. Tohmori, and S. Arai (Department of Physical Electronics, Tokyo Institute of Technology, Tokyo, 152 Japan): *Trans. IECEJ*, vol. E69, pp. 187–189, Mar. 1986.

The intensity noise spectra and their dependence on injection current and on the external reflection coefficient are measured in distributed-Bragg-reflector lasers. It is shown that the intensity noise abruptly decreases and a stable single mode operation is obtained above a certain injection current.

9

A GaAs Monolithic High-Frequency Modulator IC for Laser-Diode Noise Suppression (Letters), by T. Otsuki, T. Tanaka, N. Yoshikawa, A. Shimano, H. Takagi, and G. Kano (Semiconductor Research Laboratory, Matsushita Electronics Corporation, Takatsuki, 569 Japan): *Trans. IECEJ*, vol. E69, pp. 296–298, Apr. 1986.

A GaAs monolithic high-frequency modulator IC which provides an efficient suppression of the relative intensity noise of a laser diode is reported. The oscillation frequency and the output power of the IC are designed to be 800 MHz and 15 dBm, respectively. A reduction of 10 dB/Hz in the relative intensity noise has been obtained.

10

Fabrication of NRD-Guided PIN Switch (Letters), by Y. Serizawa*, T. Yoneyama**, and S. Nishida* (*Research Institute of Electrical Communication, Tokoku University, 980 Japan; **Faculty of Engineering, University of the Ryukyus, Okinawa, 903-01 Japan): *Trans. IECEJ*, vol. E69, pp. 331–332, Apr. 1986.

A PIN switch has been constructed in NRD (Nonradiative Dielectric) guide in which a dielectric strip is sandwiched in two conductor plates. The switch loss measured at 35 GHz is shown.

11

High-Silica Guided-Wave Hybrid Optical Transmitting-Receiving Module (Letters), by S. Sumida, Y. Yamada, M. Yasu, and M. Kawachi (NTT Electrical Communications Laboratories, Ibaraki, 319-11 Japan): *Trans. IECEJ*, vol. E69, pp. 352–354, Apr. 1986.

Hybrid integration of light sources and a photodetector with high-silica channel waveguides on a silicon substrate is demonstrated for optical transmitting-receiving module use. The individual loss is discussed in detail based upon theoretical and experimental results.

12

DIP Type Single Mode Fiber Laser Diode Module with High Reliability (Letters), by J. Yamashita, Y. Miyake, E. Nakagawa, S. Itoh, H. Watanabe, Y. Sakazaki, and H. Namizaki (Information Systems and Electronics Development Laboratory, Mitsubishi Electric Corp., Kamakura, 247 Japan): *Trans. IECEJ*, vol. E69, pp. 355–356, Apr. 1986.

A dual in-line package type single-mode-fiber laser diode module assembled by high reliable laser welding process has been developed. The coupling efficiency of this module is 4.7 dB and no degradation has been recognized after a long time heat cycle test.

13

Low Threshold $\lambda/4$-Shifted InGaAsP/InP DFB Lasers (Letters), by M. Usami, S. Akiba, and K. Utaka (KDD Research and Development Labs., Tokyo, 153 Japan): *Trans. IECEJ*, vol. E69, pp. 385–388, Apr. 1986.

The design and lasing characteristics of quarter-wavelength ($\lambda/4$)-shifted distributed feedback (DFB) laser diodes are presented. The threshold current (I_{th}) of a 1.5-μm range InGaAsP/InP $\lambda/4$-shifted DFB laser with low-reflectivity ends is theoretically expected to be 10 mA or less. Experimentally, I_{th} of 14–16 mA at 20°C and the sub-mode suppression ratio of about 35 dB or more in the temperature range of 10–70°C have been obtained.

14

TE/TM Ratio in InGaAsP/InP λ/4-Shifted DFB Lasers with Non-Reflective Ends (Letters), by S. Akiba, M. Usami, and K. Utaka (KDD Research and Development Laboratories, Tokyo, 153 Japan): *Trans. IECEJ*, vol. E69, pp. 389–391, Apr. 1986.

Corrugated waveguide parameters and the threshold current densities of the TE and TM modes in InGaAsP/InP λ/4-shifted DFB lasers with non-reflective ends are calculated. It is shown from the calculation that a TE/TM ratio over 30 dB can be obtained. A TE/TM ratio of 35 dB in a directly modulated condition has been obtained by experiment.

15

An Array of GaAlAs Composite-Cavity Lasers Monolithically Integrated with Photodetectors (Letters), by M. Hirose, M. Kume, A. Yoshikmawa, T. Shibutani, T. Sugino, K. Itoh, G. Kano, and I. Teramoto (Semiconductor Laboratory, Matsushita Electronics Corporation, Takatsuki, 569 Japan): *Trans. IECEJ*, vol. E69, pp. 392–394, Apr. 1986.

An array of monolithically integrated composite-cavity lasers which has been fabricated by chemical etching technique is reported. Each composite-cavity laser consists of a laser and an external reflector. The reflector is also used as a photodetector. The array is designed so that each laser can be operated independently. An experimental device has successfully been fabricated.

16

Characterization of a Dynamic Spectral Width of an InGaAsP/InP Electroabsorption Light Modulator (Letters), by M. Suzuki, Y. Noda, and Y. Kushiro (KDD Research and Development Labs., Tokyo, 153 Japan): *Trans. IECEJ*, vol. E69, pp. 395–398, Apr. 1986.

An electroabsorption (EA) or Franz-Keldysh effect intensity modulator is promising for a high-performance external modulator. In this letter, first, an analytical formula of the power spectrum of intensity- and phase-modulated output light from an EA modulator under large-signal sinusoidal modulation is presented. Second, the dynamic spectral broadening factor of an InGaAsP/InP EA modulator is characterized from measured and calculated power spectra.

17

Surface-Emitting-Type Optical Gate Device (Letters), by J. Nitta*, Y. Koizumi**, and K. Iga** (*Faculty of Science and Technology, Keio University, Yokohama, 223 Japan; **Research Laboratory of Precision Machinery and Electronics, Tokyo Institute of Technology, Yokohama, 227 Japan): *Trans. IECEJ*, vol. E69, pp. 399–402, Apr. 1986.

A surface-emitting-type optical gate device is proposed. The device is designed to operate both by a forward bias and a reverse bias to attain a high extinction ratio. The operation is analyzed by using rate equations. A transmission loss of 20 dB has been observed.

18

Design Consideration for Guided-Wave Light Modulators with Coplanar Waveguide Type Electrodes (Letters), by M. Izutsu, H. Nakanishi, and T. Sueta (Faculty of Engineering, Osaka University, Toyonaka, 560 Japan): *Trans. IECEJ*, vol. E69, pp. 415–417, Apr. 1986.

The modulation performance of traveling-wave type $LiNbO_3$ guided-wave light modulators with coplanar waveguide structure is studied. The analysis shows that the use of a y-cut plate offers a low voltage modulation with decreased electrode separation, although the characteristic impedance becomes low.

19

1.5 μm InGaAsP Fabry-Perot Cavity Type Laser Amplifiers, by T. Mukai, T. Saitoh, and O. Mikami (NTT Electrical Communications Labs., Musashino, 180 Japan): *Trans. IECEJ*, vol. J69-C, pp. 422–433, Apr. 1986.

Theoretical and experimental studies on the signal gain saturation and noise characteristics for 1.5-μm InGaAsP Fabry-Perot type amplifiers have been made for different amplifier material and structural parameters. High saturation output and low noise characteristics are measured with thinner active layer devices. This fact is explained by the dependences of the saturation intensity and the population inversion parameter on the gain coefficient.

20

Direct Modulation Properties of Bundle-Integrated Guide, Dynamic Single Mode (BIG-DSM) Lasers (Letters), by L. Posadas, Y. Tohmori, K. Komori, S. Arai, and Y. Suematsu (Department of Physical Electronics, Tokyo Institute of Technology, Tokyo, 152 Japan): *Trans. IECEJ*, vol. E69, pp. 583–586, 1986.

Direct modulation characteristics (the side mode suppression ratio and the dynamic wavelength shift) of BIG-DBR (bundle integrated guide distributed bragg reflector) lasers have been investigated by applying both sinusoidal and pulse-like modulations to two different samples with 100-μm and 200-μm active region lengths. The higher side mode suppression ratio of more than 30 dB has been obtained for the active region of 100 μm.

21

Low Threshold GaInAsP/InP Surface Emitting Laser (Letters), by S. Uchiyama and K. Iga (Research Laboratory of Precision Machinery and Electronics, Tokyo Institute of Technology, Yokohama, 227 Japan): *Trans. IECEJ*, vol. E69, pp. 587–588, May 1986.

In order to reduce the threshold current of a GaInAsP/InP surface emitting junction laser, a mirror with a high reflectivity, made of SiO_2 on a metal, has been introduced. The minimum threshold has been reduced down to 18 mA at 77 K which is about a half the previous cases (35 mA). The operating temperature is raised up to $-10°C$.

22

Wavelength Stabilization of a Semiconductor Laser in High Speed Modulation by Using the Rb–D_2 Absorption Line, by T. Sato, H. Sugai and M. Shimba (Faculty of Engineering, Niigata University, Niigata, 950-21 Japan): *Trans. IECEJ*, vol. J69-C, pp. 600–608, May 1986.

The wavelength stabilization of a semiconductor laser under high speed modulation is reported. The stabilization method utilizes the difference between an atomic absorption line and oscillation wavelength as a feedback signal. It has been found that the oscillation wavelength width becomes broader by generated sidebands under high speed modulation, which distorts the feedback signal and therefore degrades the stability.

23

Effect of Temperature on Conversion Efficiency of Optical Four-Wave Parametric Upconverters (Letters), by K. Koyanagi, T. Mishima, and I. Sakuraba (Faculty of Engineering, Hokkaido University, Sapporo, 060 Japan): *Trans. IECEJ*, vol. J69-C, pp. 701–703, May 1986.

This paper reports a theoretical study of the effect of temperature of metal vapor on the photon conversion efficiency of optical four-wave parametric upconverters. The allowed temperature tolerance is found to have a maximum value when the angle phase matching is employed.

24

Focusing Characteristics of Cylindrical Luneburg Lens (Numerical Analysis in Wave Optics), by K. Mori, S. Yamaguchi, and T. Hosono (College of Science and Technology, Nihon University, Tokyo, 101 Japan): *Trans. IECEJ*, vol. J69-C, pp. 731–739, June 1986.

Electromagnetic fields in and out of the cylindrical Luneburg lens are analyzed by the wave theory. For several numerical methods, the relations between the computation errors and the computation times are compared. It is shown that the method, using power series solution combined with an asymptotic solution of wave equation, is effective to the analysis of electromagnetic fields in a cylindrical Luneburg lens with a large radius. Focusing and heating characteristics of Luneburg lens are also analyzed.

25

Optimum Injection Timing for an Injection Locked Dye Laser (Letters), by Y. Inoue, and T. Sakurai (Faculty of Engineering, Yamanashi University, Kofu, 400 Japan): *Trans. IECEJ*, vol. J69-C, pp. 775–778, June 1986.

The optimum injection timing for an injection locking of a pulsed dye laser is measured as a function of pumping intensity. The result agrees with the theoretical analysis, which shows that the population inversion at the optimum injection timing is always constant.

26

Simultaneous Stabilization of Spectral Linewidth and Oscillation Frequency of an External-Cavity Laser Diode by Fiber-Optic Ring-Resonators by S. Tai, K. Kyuma, and K. Hamanaka (Central Research Laboratory, Mitsubishi Electric Corporation, Amagasaki, 661 Japan): *Trans. IECEJ*, vol. J69-C, pp. 842–848, July 1986.

The spectral linewidth and the oscillation frequency of an external-cavity laser diode have been simultaneously stablized by controlling the phase of feedback light and the injection current of laser source. Two fiber-optic ring-resonators are used as a linewidth discriminator and a frequency discriminator in the automatic control loop. A linewidth of 2 MHz with a fluctuation less than 10 kHz and the frequency fluctuation less than 2 MHz have been obtained.

27

Condition for Single Longitudinal Mode Oscillation of DFB Laser Considering Reflection from Optical Fiber Facet (Letters), by M. Katsuki, M. Matsuhara, and N. Kumagai (Faculty of Engineering, Osaka University, Suita, 565 Japan): *Trans. IECEJ*, vol. J69-C, pp. 1073–1074, Aug. 1986.

It is shown that the reflection of light on the facet of optical fiber is used for a single longitudinal mode operation of a DFB laser. A numerical analysis is made.

28

Mass Transport Buried Heterostructure Laser Using p-InP Substrate (Letters), by S. Koentjoro, K. G. Ravikumar, K. Shimomura, K. Komori, S. Arai,and Y. Suematsu (Department of Physical Electronics, Tokyo Institute of Technology, Tokyo, 152 Japan), *Trans. IECEJ*, vol. E69, pp. 920–922, Sept. 1986.

Mass-transport and conventional burying techniques are combined to fabricate narrow active stripes lasers. The lowest threshold current of 9.6 mA has been obtained for an active layer width of 1 μm in 1.5-μm wavelength CW operation. The maximum light output power of 10.6 mW and a differential quantum efficiency of 17 percent/facet have been obtained.

29

GaInAsP/InP Surface Emitting Laser with Flat Surface Circular Buried Heterostructure (Letters), by S. Uchiyama*, and K. Iga** (*Faculty of Engineering, Chiba University, Chiba, 260 Japan; **Research Laboratory of Precision Machinery and Electronics, Tokyo Institute of Technology, Yokohama, 227 Japan): *Trans. IECEJ*, vol. E69, pp. 923–924, Sept. 1986.

In order to reduce the threshold current of GaInAsP/InP surface emitting (SE) laser, a flat surface circular buried heterostructure (FCBH) has been introduced into GaInAsP/InP SE lasers. Its minimum threshold current is 20 MA at 77 K, which provides better results than previ-

ous planar buried heterostructure SE lasers or buried structure SE lasers grown with a SiO_2 mask.

30

A Theoretical Analysis of Lasing Gain and Threshold Current in GaAs-AlGaAs SCH Lasers, by M. Yamada, S. Ogita, T. Miyabo, and Y. Nashida (Faculty of Technology, Kanazawa University, Kodatsuno, Kanazawa, 920 Japan): *Trans. IECEJ*, vol. E69, pp. 948–955, Sept. 1986.

A theoretical analysis of lasing gain and threshold current in GaAs-AlGaAs graded-index separate confinement heterostructure lasers is given. Energy levels and state densities for electron distribution in both well layer and the optical guiding regions are formulated. The injection current, electron lifetime due to the radiative recombination, lasing gain, and threshold current are calculated by taking into account the intraband relaxation effect of the electron wave.

31

Theoretical Analysis of Waveguide Laser Amplifier Using Nd Doped Garnet Crystalline Thin Film, by M. Yamaga, K. Yusa, and Y. Miyazaki (Faculty of Engineering, Toyohashi University of Technology, Toyahashi, 440 Japan), *Trans. IECEJ*, vol. E69, pp. 956–967, Sept. 1986.

Wave-guide-type laser amplifiers have been constructed in Nd doped yittrium gallium garnet crystalline thin films deposited on yittrium aluminum garnet substrates. Numerical calculations of gains, signal-to-noise ratios and pulse response of the optical signal for these amplifiers are presented.

32

Waveguide-type Optical Isolator Using the Faraday and Cotton-Mouton Effects, by T. Mizumoto, Y. Kawaoka, and Y. Naito (Faculty of Engineering, Tokyo Institute of Technology, Tokyo, 152 Japan): *Trans. IECEJ*, vol. E69, pp. 968–972, Sept. 1986.

Design of a waveguide-type optical isolator is presented. The isolator uses Faraday and Cotton-Mouton effects for nonreciprocal and reciprocal mode conversions, respectively. It has been found that the device length can be made shorter, by allowing phase-mismatch between TE and TM modes in the waveguide, than that by the phase-matched design.

33

Proposal and Analysis of an Integrated Laser with External Injection of Spontaneous Emission, by M. Yamada, M. Ohki, and H. Yamamoto (Faculty of Technology, Kanazawa University, Kanazawa, 920 Japan): *Trans. IECEJ*, vol. E69, pp. 973–979, Sept. 1986.

An integrated laser having increased rate of the spontaneous emission is proposed to apply this device to a light source with weak optical coherency. This device consists of two sections, a light-emitting-diode (LED) section and a laser section. The spontaneous emission is generated and amplified in the LED section, then is injected into the laser section. Power of the incoherent light in the laser section becomes more than ten times that in the conventional single section laser with the help of the light injection. Mechanism of this device are analyzed by classical Maxwell's equation and quantum mechanics.

34

Proposal of Laser Diode Integrated-Optical Matrix Switches (Letters), by M. Ikeda (Faculty of Engineering, Tokushima University, Tokushima, 770 Japan): *Trans. IECEJ*, vol. E69, pp. 1075–1076, Oct. 1986.

Monolithic integrated-optical matrix switches (LD matrix switches) using laser diode gain guides have been proposed. LD matrix switches have been fabricated on a 1.5-μm-DH wafer by a dry process. Optical switching characteristics are presented.

35

Quasi-Matched-Velocity Traveling-Wave Type Electrodes for Light Modulators and Its Analysis, by M. Sanagi, and M. Nakajima (Faculty of Engineering, Kyoto University, Kyoto, 606 Japan): *Trans. IECEJ*, vol. J69-C, No. 10 pp. 1291–1296, Oct. 1986.

It is required to match two velocities of modulation wave and light wave for broadening the bandwidth of light modulators. For that purpose, material of low dielectric constant is inserted partially between electrodes and substrate. By numerically analyzing the structures by means of the boundary element method, an optimized electrode configuration has been obtained.

36

Characteristics of Leaky Surface Acoustic Waves on $LiNbO_3$ and the New Cut, by Y. Shimizu, and K. Murakami (The Center For Research and Development of Educational Technology, Tokyo Institute of Technology, Tokyo, 152 Japan): *Trans. IECEJ*, vol. J69-C, pp. 1309–1318, Oct. 1986.

The propagation characteristics of leaky surface acoustic waves (SAW) on $LiNbO_3$ are theoretically and experimentally investigated. A new cut with zero slope temperature coefficient of delay and with high electro-mechanical coupling constant has been theoretically discovered. The propagation of leaky surface wave on the new cut is verified by experiments.

37

Impulse Response of Partially Depleted p-i-n Photodiode, by J. Machac (Institute of Radio Engineering and Electronics, Czechoslovac Academy of Sciences, Lumumbova, 1, 182 51 Praha 8, Czechoslovakia): *JIETE* (India), vol. 32, pp. 28–32, Jan.–Feb. 1986.

Impulse response of partially depleted p-i-n photodiode is calculated by solving the continuity equation and Poisson's equation. The problem is solved by an iterative procedure. Photodiode response is computed for step switch-off of photon flux using various p-i-n diode configurations with various applied reverse bias and various

incident light wavelengths. Strong wavelength dependence of current responses is obtained. The agreement between calculated and experimental data is good.

38

Integrated Electro-Optic Modulators and Switches, by P. S. Chung (Faculty of Science, the Chinese University of Hong Kong, Shatin, New Territories, Hong Kong): *JEEE* (Australia), vol. 6, pp. 308–320, Dec. 1986.

In optical communication systems and signal processing applications, integrated optical modulators/switches are important components. In this paper, a review of the state-of-the-art in optical guided-wave devices using the electro-optic effect is presented. The principles and the performance characteristics of some promising electro-optic waveguide modulators and switches using titanium-indiffused lithium niobate technology are presented and discussed.

7) Optical Fibers/Waveguides

1

Vectorial Wave Analysis of Stress-Applied Polarization-Maintaining Optical Fibers, by K. Hayata, M. Koshiba, and M. Suzuki (Faculty of Engineering, Hokkaido University, Sapporo, 060 Japan): *Trans. IECEJ*, vol. J69-C, pp. 17–24, Jan. 1986.

The transmission characteristics of stress-applied polarization-maintaining optical fibers with low-index inner cladding are analyzed. The analysis is based upon the vector H-field finite-element method. The accuracy of calculation is discussed for a step-index circular fiber. Further, the radiation power due to transverse offset, longitudinal separation, and angular misalignment of two stress-applied fibers are discussed.

2

Determination of Friction Coefficient between Coated Optical Fibers and a Stranded Loose-Tube (Letters), by Y. Katsuyama, K. Hogari, S. Hatano, and T. Matsumoto (NTT Electrical Communications Labs., Ibaraki, 319 Japan): *Trans. IECEJ*, vol. E69, pp. 86–88, Feb. 1986.

Friction coefficient between optical fiber ribbons and a loose-tube is theoretically and experimentally investigated. Measured friction coefficient with a short test cable wound on a drum has been found to represent the frictional force to pull the ribbons from a long straight cable.

3

Novel Waterproof Optical Fiber Cable with Absorbent Polymer Yarn (Letters), by S. Kukita, M. Kawase, and F. Nihei (NTT Electrical Communications Labs., Ibaraki, 319-11 Japan): *Trans. IECEJ*, vol. E69, pp. 89–91, Feb. 1986.

A new waterproof optical fiber cable, which uses absorbent polymer yarn instead of the conventional jelly-compound as a filling material, is proposed. This yarn limits the length of water penetration into cable less than 10 cm that is short enough to guarantee long-term reliability. It has also been found that the cable has superior characteristics for dynamic bend-tension test.

4

Quantitative Measurement of High Resistivity of Optical Damage in Proton-Exchanged $LiNbO_3$ Optical Waveguides (Letters), by Y. Fujii, and S. Tanikoshi (Institute of Industrial Science, The University of Tokyo, 106 Japan): *Trans. IECEJ*, vol. E69, pp. 95–96, Feb. 1986.

The optical damage in proton-exchanged and Ti-indiffused $LiNbO_3$ optical waveguide are measured by photorefractive (photoinduced) grating method. The measured optical damage in the proton-exchanged waveguide is found to be 10^{-4} times that in Ti-indiffused waveguide.

5

High Coupling Lamb Waves Propagating in a ZnO/SiO_2 Composite Membrane (Letters), by M. Yamaguchi, K. Hashimoto, M. Tanno, and H. Kogo (Faculty of Engineering, Chiba University, Chiba, 260 Japan): *Trans. IECEJ*, vol. E69, pp. 97–98, Feb. 1986.

This paper deals with theoretical analysis on Lamb waves propagating in a composite membrane on ZnO and SiO_2. Calculation is made for the lowest pseudo-symmetric (S_0) and antisymmetric (A_0) modes. It is shown that when the thickness of each film is of the order of 0.1 wavelength or less, S_0 mode has a large electromechanical coupling coefficient of about 6% and a velocity more than 5,000 m/s. A_0 mode has a quite small velocity less than 1,500 m/s with an electromechanical coupling coefficient of about 3%.

6

A Simple Measurement Technique for the Refractive-Index Change Caused by the Thermooptic Effect, by K. Kishioka (Faculty of Engineering, Osaka Electro-Communication University, Neyagawa, 572 Japan): *Trans. IECEJ*, vol. J69-C, pp. 182–189, Feb. 1986.

A simple measurement technique for the thermally induced refractive-index change of glass is proposed. The index change is calculated from the measured deflection angle. The measurement accuracy is also discussed by comparing the measured temperature coefficients of the refractive index with previously reported results.

7

Loss Analysis of a Single-Mode 5-Fiber Plastic Connector (Letters), by T. Satake, and S. Nagasawa (NTT Electrical Communications Labs., Ibaraki, 311-19 Japan): *Trans. IECEJ*, vol. E69, pp. 180–182, Mar. 1986.

A demountable optical connector for a single-mode fiber-ribbon has been developed by use of a multiple V-groove molding method. The connecting loss due to the errors in ferrule fabrication is analyzed in detail. The average connecting loss for 5-fiber connectors has been obtained.

8

A Fiber-Optic Fabry-Perot Resonator and Its Application to Mode Analysis (Letters), by M. Imai (Faculty of Engineering, Hokkaido University, Sapporo, 060 Japan): *Trans. IECEJ*, vol. E69, pp. 183–186, Mar. 1986.

The resonant modes and their properties of a fiber-optic Fabry-Perot resonator are discussed. The resonator is made by RF-sputtered Ag thin film on both end faces of a short piece of a quasi-single mode fiber. In order to obtain anisotropic and vectorial properties of optical fiber modes, the characteristic parameters resulting from fiber Fabry-Perot configuration are determined.

9

Relation between Sheath Thickness and Allowable Lateral Load for Small Diameter Optical Cables (Letters), by K. Mihara, N. Uesugi, and C. Tanaka (NTT Electrical Communications Labs., Ibaraki, 319-11 Japan): *Trans. IECEJ*, vol J69-B, pp. 285–287, Mar. 1986.

Lateral load characteristics of small diameter optical fiber cables are measured for different sheath-thicknesses. The experiment shows that the allowable load to suppress loss-increase is well explained by a theory in which sheath distortion is taken into consideration.

10

An Efficient TE-TM Mode Converter Using a Z-Propagation $LiNbO_3$ Waveguide (Letters), by M. Hamura, J. Shimada, and H. Nishihara (Faculty of Engineering, Osaka University, Suita, 565 Japan): *Trans. IECEJ*, vol. E69, pp. 418–419, Apr. 1986.

This letter presents experimental results of an efficient TE-TM mode converter using a Z-propagation $LiNbO_3$ waveguide. The drive voltage is 5.2 V with a mode conversion efficiency of 98% when the phase matching condition is satisfied. This mode converter is free from optical damage due to the use of Z-propagation $LiNbO_3$ waveguide.

11

Analysis of the Electromagnetic Fields at the Facet of Optical Fibers and of Dielectric Rod Antennas, by I. Toyoda, M. Matsuhara, and N. Kumagai (Faculty of Engineering, Osaka University, Suita, 565 Japan): *Trans. IECEJ*, vol. J69-C, pp. 406–412, Apr. 1986.

The electromagnetic fields at the facet of an optical fiber are theoretically investigated by the eigenmodes expansion method. For simplicity, the closed-type waveguide model is used in the analysis. The stationary-phase method is use to analyze the radiation pattern at the facet of the optical fiber. The electromagnetic fields and the radiation pattern of a dielectric rod antenna are also investigated by the same method.

12

Three-Dimensional Treatment of Optical Fiber by Bergeron's Method (Letters), by Y. Tejika, N. Yoshida, and I. Fukai (Faculty of Engineering, Hokkaido University, Sapporo, 060 Japan): *Trans. IECEJ*, vol. J69-C, pp. 769–798, June 1986.

The free-boundary conditions in the three-dimensional transient analysis of single mode optical fibers by Bergeron's Method is presented.

13

OH Loss Increase due to Jacketing Glass Material in Optical Fibers (Letters), by H. Itoh, H. Hanafusa, and Y. Hibino (NTT Electrical Communications Labs., Ibaraki, 319-11 Japan): *Trans. IECEJ*, vol. E69, pp. 782–784, July 1986.

The dependence of the OH loss increase in optical fibers on drawing conditions for quartz-jacketed and synthesized-silica-jacketed fibers is investigated. The OH loss increases with the increase in drawing temperature and with the decrease in drawing speed in the former, whereas the loss does not vary with the drawing conditions in the latter.

14

Optical Switching Networks Using Tree-Structured Waveguide Optical Switches, by K. Habara, and K. Kikuchi, (NTT Electrical Communications Labs., Musashino, 180 Japan): *Trans. IECEJ*, vol. J69-B, pp. 675–664, July 1986.

This paper proposes optical switching networks using tree-structured $N \times 1$ waveguide optical switches. An experimental 4×4 time-division space switch is demonstrated. High signal-to-crosstalk ratio and low insertion loss have been obtained.

15

Numerical Analysis of Silicon-Clad Planar Optical Waveguides, by H. Kumagai, M. Koshiba, and M. Suzuki, (Faculty of Engineering, Hokkaido University, Sapporo, 060 Japan): *Trans. IECEJ*, vol. J69-C, pp. 856–864, July 1986.

A silicon-clad planar diffused optical waveguide with an exponential function index profile is proposed. The TE- and TM-mode propagation characteristics are analyzed by the finite element method. The computer modelling indicates that the attenuation and mode index show a similar characteristics to those in the damped periodic oscillation. It is further noted that the change in conductivity of silicon produces a relatively large change in the attenuation and mode index.

16

Characteristics of Optical Waveguide with SiC Ceramic (Letters), by H. Horiuchi, C. Sinbo, K. Nagai, and T. Simada (Central Research Laboratory, Hitachi Ltd., Kokubunji, 185 Japan): *Trans. IECEJ*, vol. J69-C, pp. 943–945, July 1986.

A SiC ceramic optical waveguide for CO_2 laser is compared with BeO ceramic. SiC ceramic waveguide provides low waveguide loss as well as BeO ceramic. A CW CO_2 laser with a 3.2-W output power by the use of a SiC

waveguide and a 132-nm effective discharge length has been achieved.

17

Water Propagation Blocking Properties of Submarine Optical Fiber Cable, by N. Yoshizawa, M. Ohnishi, K. Ishihara, and Y. Negishi (NTT Electrical Communications Laboratories, Ibaraki, 319-11 Japan): *Trans. IECEJ*, vol. J69-C, pp. 991–998, Aug. 1986.

A submarine optical fiber cable with excellent water propagation blocking has been developed. Basic design concepts and water blocking properties, as well as transmission characteristics of the cable are shown. Propagation of water is estimated to be less than 800 m per month at a depth of 8000 m.

18

Temperature Characteristics of Optical Cable Using Oriented Polyoxymethylene as Strength Members (Letters), by N. Kuwabara, H. Koga, T. Konaka, and Y. Ishida (NTT Electrical Communications Labs., Ibaraki, 319-11 Japan): *Trans. IECEJ*, vol. J69-C, pp. 1084–1087, Aug. 1986.

The temperature characteristics of an optical cable using ultra-oriented polyoxymethylene as strength members are described. It is theoretically and experimentally clarified that the cable has a very small linear expansion coefficient due to a negative liner expansion coefficient of the polyoxymethylene and has stable temperature characteristics of optical loss in a wide temperature range.

19

Waterproof Flame-Resistant Filling Compound for Fiber Optical Cable (Letters), by S. Matsumoto* and H. Ohshima** (*NTT Electrical Communications, Labs., Ibaraki, 319-11 Japan; **NTT Electrical Communications Labs., Musashino, 180 Japan): *Trans. IECEJ*, vol. J69-B, pp. 1011–1013, Sept. 1986.

A water proof flame-resistant filling compound has been developed for fiber optical cables. The compound, made of a liquid phosphoric ester and a metallic hydroxide for the flame retardant, contains no halogens which generate poisonous gases when burned.

20

Electrically Deposited Germanium-Coated Circular Metallic Hollow Waveguides for Infrared Radiation, by M. Miyagi*, Y. Shimada*, A. Hongo**, and S. Nishida* (*Research Institute of Electrical Communication, Tohoku University, Sendai, 980 Japan; **Cable Research Laboratory, Hitachi Cable Ltd., Hitachi, 319-14 Japan): *Trans. IECEJ*, vol. J69-C, pp. 1159–1165, Sept. 1986.

Germanium-coated metallic hollow waveguides for transmission of CO_2 laser have been fabricated by electrodeposition. Dependence of thickness of deposited germanium layer on the cathode current density, temperature of deposition bath, and deposition time have been clarified. Low-loss property of the waveguides has been proved.

21

Launching and Receiving Conditions for Optical Fiber Loss Measurements using an OTDR, by S. Furukawa*, and Y. Koyamada** (*NTT Electrical Communications Labs., Ibaraki, 311-41 Japan; **NTT Electrical Communications Labs., Musashino, 180 Japan): *Trans. IECEJ*, vol. J69-C, pp. 1148–1158, Sept. 1986.

Launching and receiving conditions for measuring the optical fiber loss and splice loss of graded-index multimode fibers by an optical time domain reflectometer (OTDR) are theoretically and experimentally studied. It has been found that the receiving mode distribution in the back-scattered power is an important factor to measure the fiber loss. This paper also presents a simple and accurate (accuracy: 0.1 dB) measuring method of splice loss using the OTDR.

22

Stress-Applied Optical Fiber Having Inhomogeneous Core, by K. Hayata, M. Koshiba, and M. Suzuki (Faculty of Engineering, Hokkaido University, Sapporo, 060 Japan): *Trans. IECEJ*, vol. J69-C, pp. 1404–1410, Nov. 1986.

A stress-applied fiber having inhomogeneous core is proposed and analyzed. The finite-element method is used for both the stress and modal analyses. It is found that the absolutely single-polarization operation can be realized in stress-applied fibers by selecting an appropriate refractive-index profile in the core.

23

The Design Method for Triple Clad Silica Core Optical Fibers with Zero Total Dispersion at Wavelengths of 1.3 μm and 1.55 μm, by S. Furukawa*, K. Nakazawa**, T. Hinata**, and T. Hosono (*Amano Corporation, Yokohama, 222 Japan; **College of Science and Technology, Nihon University, Tokyo, 101 Japan): *Trans. IECEJ*, vol. J69-C, pp. 1411–1421, Nov. 1986.

The design method to realize two zeros of the total dispersion at wavelengths of 1.3 μm and 1.55 μm are investigated for silica-core single-mode optical fibers with triple clad. For ideal and nonideal profiles, the refractive index difference and bending loss are discussed.

24

Finite-Element Method Analysis of Microwave and Optical Waveguides (Trends in Countermeasures to Spurious Solutions), by M. Koshiba, K. Hayata, and M. Suzuki, (Faculty of Engineering, Hokkaido University, Sapporo, 060 Japan): *Trans. IECEJ*, vol. J69-C, pp. 1477–1486, Dec. 1986.

This paper presents a review of the finite-element analysis for microwave and optical waveguides. The most serious difficulty in using the finite-element analysis for inhomogeneous waveguides with arbitrarily-shaped cross sections is the appearance of the spurious nonphysical

solutions. Various approaches capable of eliminating the spurious solutions are discussed.

25

Elimination of Spurious Solutions in Vectorial Finite-Element Analysis of Dielectric Waveguides (A Method Using Transverse Magnetic-Field Component), by K. Hayata, M. Koshiba, M. Eguchi, and M. Suzuki (Faculty of Engineering, Hokkaido University, Sapporo, 060 Japan): *Trans. IECEJ*, vol. J69-C, pp. 1487–1493, Dec. 1986.

A new finite-element analysis of dielectric waveguides is proposed. In this analysis, the divergence-free relation is satisfied and spurious solutions are perfectly eliminated in the whole region of the dispersion diagram. Numerical results for a partially dielectric-loaded rectangular waveguide are compared with those obtained by conventional finite-element analyses.

26

An Analysis of the Effect of Lossy Jacketed Fibre on Propagation Constant, by A. Alphones* (*Center for Research and Training in Radar and Communication, India Institute of Technology, Kharagpur 721 302 India; and G. S. Sanyal; **Indian Institute of Technology, Kharagpur 721 302 India): *JIETE* (India), vol. 32, pp. 123–125, May–June 1986.

A theoretical investigation has been done on propagation constant with lossless and lossy jackets of an optical fiber. In this analysis, a single-mode step-index fiber in long wavelengths range is considered. Two determinants representing the eigenvalue equations for the lossless and lossy coatings are derived. The eigenvalues are computed and the results are discussed.

8) Superconductive Devices

1

Fabrication of NbN Josephson Junction Integrated Circuits Using Si Insulation Layer, by M. Hirano, H. Mori, Y. Tarutani, and S. Yano (Central Research Laboratory, Hitachi Ltd., Kokubunji, 1985 Japan) *Trans. IECEJ*, vol. J69-C, pp. 66–75, Apr. 1986.

In order to improve the uniformity of the critical current (I_{m0}) for NbN/Nb:Oxide/PbInAu junction of a size 1.5 μm, fabricating processes of cross-shaped junction windows and insulating film have been developed. The scattering of the I_{m0} is caused by the change in junction area, due to the existence of SiO remnant in the junction. By use of Si for the insulating film, the scattering of the I_{m0} has been improved to $\pm 12\%$, which is about one-half that for the conventional cases where SiO is used.

2

Fabrication of Self-Alignment Micro-Contact Josephson Junctions (Letters), by N. Hirose, Y. Harada, S. Yoshimori, and M. Kawamura (Faculty of Engineering, Tokyo Institute of Technology, Tokyo, 152 Japan): *Trans. IECEJ*, vol. E69, pp. 425–426, Apr. 1986.

Micro-contact Josephson junctions have been fabricated by self-alignment process, using double-layer-resist electron beam exposure. The superconducting material is Nb. A millimeter-wave (70 GHz) radiation of 100 μW and the 7th Shapiro step has been observed.

3

All-NbN Edge Junction Nanobridges as Josephson Mixers (Letters), by T. Yakihara*, K. Hamasaki*, T. Yamashita*, T. Matsui** and R. Hayashi** (*Department of Electronics, Technological University of Nagaoka, Nagaoka, 949-54 Japan; **Radio Research Lab. Ministry of Posts and Telecommunications, Koganei, 184 Japan): *Trans. IECEJ*, vol. E69, pp. 427–429, Apr. 1986.

The reproducibility of All-NbN edge junction nanobridges has been improved. The bridges show a sharply defined critical current, a high resistance (100 Ω), a sharp gap structure at about 4 mV, a large I_0R_n product, and a low excess current. The sharp LC resonance step of about 1.5 mV is observed in the nanobridge SQUID's. The noise equivalent power is of the order of 10^{-19} W/Hz in Josephson mixing at 101 GHz.

4

Analysis of Josephson Triode, by S. Yoshimori and M. Kawamura (Faculty of Engineering, Tokyo Institute of Technology, Tokyo, 153 Japan): *Trans. IECEJ*, vol. J69-C, p. 636–643, May 1986.

Characteristics of the Josephson triode are analyzed. It is found that there exists an interaction between the oscillator junction and the converter junction. The current steps similar to Shapiro steps are induced due to this interaction. The heterodyne detection characteristics of the millimeter-wave using the triode are also discussed.