PANEL DISCUSSION

TECHNOLOGY FORECASTING AND ASSESSMENT

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Abstract

Four experts in microwave technology will address the audience. These experts will attempt to forecast and assess the impact of their technology on future components and systems. Subjects to be covered include solid state power generation, energy transmission via microwave, microwave packaging, and millimeter waves. It is desired to have a free exchange of information and questions between the audience and panel members. A summary of both the audience and panel member discussions and comments will be published in the S-MTT Newsletter.

Technology Forecasting of Solid State Microwave Generation and Application - T. A. Midford, Hughes Aircraft Company, Torrance, CA 90509

During the 13 years since J. B. Gunn's first observation of bulk electrical instabilities in gallium arsenide and indium phosphide, the technology and applications of active microwave solid state devices have advanced rapidly. Currently, development in this field is entering a phase which is highly materials-and-process intensive. Relatively simple structures such as IMPATT and Gunn diodes are being challenged by both bipolar and field effect transistors at frequencies through 20 GHz. The performance of these three terminal devices is in general superior to that of diodes. Along with, and partially as a consequence of this improved performance, increasingly stringent demands are being placed on materials and device processing technology. How well these demands are met will have a substantial future impact on performance, yield (and hence cost), and reliability as well as the rate at which further advances are made.

Significant trends which will be examined include: (1) the rapid increase in the development effort applied to III-V materials and devices, (2) problems and limitations of conventional processing and the degree to which solutions will be provided by machine processing (such as ion implantation and electron beam lithography), and (3) the increasing importance of reliability assessment at an early stage in device development. The economic implications of these trends will also be projected.

Free Space Microwave Power Transmission Technology and Applications - Present and Future - W. C. Brown, Raytheon Company, Waltham, MA 02154

The technology for the transmission of power through free space by means of microwave is defined to include both the highly collimated microwave beam and the interconversion of ordinary electrical power and microwave power at both ends of the system. Using this definition, the overall system efficiency (DC in to DC out) has recently been increased by NASA-supported technology developments to a certified 54%. Other technology developments have been set into motion which will further increase the overall efficiency and greatly increase the power handling capabilities of these systems.

The nature of the applications of this technology and the speed with which it will be accepted, will depend upon a variety of factors which would include: long-term national and world-wide energy requirements which could initiate systems to transmit electrical power derived from the sun in space to the earth; a limited but possibly real need for a continuous supply of weightless "fuel" to airborne vehicles of various kinds; and upon the growth burden being placed upon conventional electrical power generation and transmission systems in today's limited resource environment by their heavy dependence upon heavy rotating machinery, use of massive amounts of ordinary and critical materials, and the job-shop and contruction-site nature of much of their means toward future expansion. By contrast, no investment in a transmission medium, long life components with no rotating parts, minimal material mass requirements in system components, and the economy of mass production of simple, light-weight components are intriguing characteristics of the microwave power transmission system.

Technology Projections for Microwave Subassembly Packaging - H. Howe, Microwave Associates, Inc., Burlington, MA 01803

During the past decade, microwave subassembly packaging techniques have evolved from the single component level to a high degree of sophistication. In the years ahead this trend can be expected to continue with some modification of direction. The areas of most probable growth are:

1. Increased application of multi-media techniques incorporating newer elements such as slot lines, saw, ferrite substrates and the long forecasted monolithic MIC.
2. A higher level of active element integration.
3. An increased level of activity at frequencies above 20 GHz.
4. A greater use of lumped element circuits at frequencies below 20 GHz.
5. Continued and increased pressure to reduce costs.

These factors will be discussed in the light of present technology.

Millimeter-Wave Integrated Circuits - H. J. Kuno, Hughes Aircraft Company, Torrance, CA 90509

Approaches to the development of millimeter-wave integrated circuits may be classified into two basic types, viz., the extension of the microwave integrated circuit techniques (stripline/microstripline circuits) and the integrated optics techniques (dielectric/image guide configurations). In this paper various approaches are reviewed and their capabilities and limitations as applied to active millimeter-wave multifunctional integrated circuits are compared.