SESSION 19: MILLIMETER-WAVE TECHNIQUES

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Millimeter-wave technology offers solutions to the design and implementation of high-performance weapons and communications systems. However, these solutions depend upon making millimeter-wave systems affordable.

To make millimeter-wave systems viable, substantial size reduction in components and subsystems must be carried out. Integrated circuits of both hybrid and monolithic nature are therefore being used to accomplish the size reduction, increase reproducibility as well as bringing the costs down.

To continue the trend of making millimeter-wave systems more cost effective it is also mandatory to explore novel techniques of realizing components and subsystems. This section attempts to address both issues, i.e., millimeter-wave integration and exploration of new horizons.

As a results of the growing importance of digital communication systems an increasing interest is being shown in the design of phase modulators. Direct r.f. modulation is of interest as it simplifies transmitter designs compared to i.f. modulation schemes, leading to more compact, cheaper and efficient systems. The lead paper presents a hybrid integrated circuit QPSK exciter/modulator directly modulating a 60 GHz carrier frequency with state-of-the-art performance. An output phase error of ±3° and amplitude error of ±0.5 dB have been achieved.

The second paper reports on the latest developments in silicon millimeter-wave monolithic integrated circuits. A double drift IMPATT and PIN diodes have been fabricated using this technology. A power of 96 mw at 43 GHz has been achieved from an IMPATT diode oscillator.

The third paper addresses the issue of realizing a diople antenna by means of a process that is compatible with a GaAs integrated circuit technology. The use of such antennas will provide the circuit designer a new degree of flexibility in the realization of fully integrated radar sensors.

At millimeter-wave frequencies the propagation losses of both microstrip and coplanar waveguide are dominated by conductor losses. These losses are higher in the coplanar structure. It would be of interest to reduce these losses since this structure has several application advantages. The fourth paper in this section discusses two methods for reducing propagation losses in the coplanar waveguide. The authors claim a four to one reduction is possible.

As millimeter-wave systems approach reality a need for more attractive and practical nonreciprocal devices becomes apparent. With this in mind, it is desirable to examine some alternative means to achieve nonreciprocal behavior. The fifth paper presents the results of an investigation of nonreciprocal effects caused by partial loading of waveguide with semiconductors in a transverse magnetic field at 92 GHz. The performance achieved to date is not earthshaking however, this is only the beginning.

The final paper discusses a wideband hybrid integrated circuit receiver operating in the 90-100 GHz frequency range with state-of-the-art performance. The receiver was integrated into a small volume of 2.5 cubic inches. The single sideband noise figure of 14-16 dB was achieved.

0149-645X/84/0000-0187 $01.00 © 1984 IEEE