

## VI. SOLID-STATE MICROWAVE ELECTRONICS\*

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### RESEARCH OBJECTIVES

Our research objectives include developing fundamental performance limits and designing optimum imbedding networks for diodes in microwave applications, such as mixers, frequency multipliers, parametric amplifiers, and avalanche transit-time devices. We are also engaged in developing new techniques for high dynamic range circuits in the frequency bands below 1 MHz. These aims form the background for extending communication techniques to higher frequencies with greater sensitivity and detection capability.

During the coming year, we shall continue our low-noise solid-state millimeter-wave receiver component development and our work on avalanche diode amplifiers. We have begun an investigation of frequency-modulation methods for avalanche oscillators and have determined preliminary synthesis techniques for high-speed (nanosecond) frequency modulation of avalanche oscillators. This work will also continue.

In the high dynamic range field, we are planning to investigate iterative synthesis techniques for low-noise, high dynamic range mixers for the UHF frequency bands.

We also plan to investigate ways to improve the dynamic range of avalanche diode power amplifiers.

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### A. INSTRUMENTATION – STATUS OF RESEARCH

Two aspects of the instrumentation for mass spectrography in organic chemistry are being studied: the real-time interface of a Mattauch-Herzog double-focussing mass spectrometer and a computer, and the over-all problem of improving resolution and sensitivity.

At present, photographic plate detection, together with an automatic electrodensitometer, transfer data from the focal plane of the mass spectrometer to the computer. Substitution of this data-processing technique requires the development of a new detection device. The detector should comprise a continuous or finely divided plate that integrates the ion current at each physical point and a charge detector that scans the charge distribution on the surface. A search of possible materials (e. g., Electrofax layers) is under way.

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The problem of sensitivity and resolution can be studied as the estimation of a non-random waveform, the mass spectrum. This approach provides an orderly way to take into account different factors that degrade the possibilities of the instrument and to find out their relative importance.

A. Chu

### B. EXPERIMENTAL BROADBAND MIXER

The effects of reactive sum frequency terminations on the port impedance levels of a low-conversion-loss balanced mixer will be investigated.

A broadband UHF balanced mixer is, at present, under construction. A performance evaluation will be made before the addition of frequency selective terminations.

E. L. Caples