# Foreword

## SPECIAL ISSUE ON LOW-NOISE TECHNOLOGY

LOW-NOISE technology at microwaves has been traditionally motivated by radar, terrestrial communication, and radio astronomy applications. In recent years satellite communications and remote sensing have placed added importance on low-noise reception.

Many readers will recall the MTT TRANSACTIONS Special Issue on Noise of September 1968. This issue had many articles on noise measurements, radiometry, oscillator noise, and methods of analyzing noisy networks. In 1968 masers were still of interest. While parametric amplifiers were a fairly mature component, ultralow noise required cryogenic cooling. The low-noise GaAs MESFET (highlighted in the June 1976 MTT TRANSACTIONS) had not been exploited at all as a microwave amplifier. Regular resistive mixing was not considered much of a tool of the low-noise receiver designer. Millimeter-wave receivers were exotic laboratory equipments.

Since that time advances in microwave diode and circuit technology has made possible ultralow-noise paramps that do not require cryogenic cooling. This property has been extensively exploited in satellite communication ground stations. Low-noise MESFET's have also become major front-end components. Image-enhanced resistive mixers are also of current interest. Gunn and IMPATT diode oscillators and amplifiers have also been used to a greater degree as local oscillators, parametric amplifier pump sources, and as transmitters. Advances in understanding their noise generation mechanisms and their measurements have resulted in more use of this hardware in the field. Many advances in millimeter-wave solid-state devices and circuits have lowered the noise figure and in many instances reduced the costs of millimeter receivers. This is a key factor contributing to their increased use. This issue highlights many of these trends.

In the area of systems application, Weinreb *et al.* describe the cryogenic front-end components that are being used in a major radio astronomy installation. This includes parametric amplifiers, upconverters, and mixers. Levis and Lin study the optimum means of performing high angular resolution radiometry for earth and atmospheric sensing. Wilson describes a widely tunable millimeter-wave (70–120 GHz) superheterodyne receiver having a single-sideband noise temperature in the vicinity of 1000 K.

Okean and Kelly describe recent trends in low-noise microwave and millimeter-wave receiver design, and guide the reader into making the best choice for assembling a low-noise front end. Whelehan highlights new millimeter-wave components that result in practical low-noise receivers. Edrich's paper reports on a field operational cryogenically cooled two-channel parametric amplifier operating at 47 GHz. This system had a noise temperature of 100 K. Vernon *et al.* describe a new device, a Schottky-barrier diode consisting of a superconducting metal–semiconductor interface. This device must be cryogenically cooled but has yielded heterodyne detection noise temperatures as low as 6 K at 9 GHz.

The bane of the most sensitive front end is noise due to local oscillators or parametric amplifier pumps. Some systems also suffer from excess transmitter noise. The nature of this noise and its measurement has been treated in a tutorial paper by Ashley *et al.* Design of a cavity-stabilized IMPATT oscillator having low FM noise has been treated by van der Heyden. Goedbloed and Vlaardingerbroek's paper applies their large-signal noise theory to the accurate prediction of noise in IMPATT amplifiers.

Benson and Uhlir show means of minimizing the errors in varactor quality factor measurements.

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In 1949 he joined the Naval Material Laboratory, Brooklyn, NY, where he was concerned with new measurement techniques and standards for microwave electron devices. In 1955 he joined the AIL division of Cutler–Hammer, Inc., where he held various positions concerned with a variety of microwave and millimeter-wave techniques programs. His current position at AIL is Chief Scientist in charge of Central Research. From 1960 to 1962 he was a part-time member of the graduate faculty of the City College of New York.

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