assuming the values for γ and f_c given in Table II. The measured and theoretical values for the uncooled case disagree by only 12 percent. The larger discrepancy at 20 K is primarily due to the uncertainty in the exact temperature of the nitrogen cold-load used for the noise measurements, the relatively large second-stage contribution (30 K), and the neglect of other possible noise sources like the pump-heating effect [9].

This measured noise temperature of only 40 K constitutes an improvement of the noise performance by an order of magnitude as compared to previously reported uncooled amplifiers in this frequency range [6]. Based on these results it is felt that amplifiers with such low noise performance which are needed in many radiometry and millimeter-wave radio-astronomy applications can be developed up to frequencies of at least 90 GHz.

ACKNOWLEDGMENT

The author wishes to thank Dr. R. Mattauch of the University of Virginia for his support and for developing the junctions. He also wishes to thank L. Pizziconi, who computed the whisker stray capacitance.

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A Frequently Reinvented Circuit

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Abstract—**Attention is called to published work describing an impedance-measuring circuit that is frequently reinvented.**

A number of papers have appeared in which the VSWR or impedance is measured by sliding a short circuit in one side arm of a directional coupler and observing the response of a detector located in the other side arm. In addition, this idea has been reinvented on two different occasions of which the author is aware, and the inventors did not publish their independent work when informed of previous work.

Consequently, it appears worthwhile to call attention of microwave engineers to publications which deal with this topic. The following list may not be complete, but should be adequate for the intended purpose:

1) R. Musson-Genon and P. Brissoneau, "Sur un mesureur d'impedances a couplage directif en hyperfrequence," *C. R. Acad. Sci.*, vol. 230, pp. 1258–1259, Mar. 1950.
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4) R. K. Jha and V. K. Garg, "Voltage standing-wave ratio measurement by cross coupler," *Int. J. Electron.*, vol. 29, no. 2 pp. 179–183, 1970.

Manuscript received January 11, 1974.
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Generation of Acoustic Signals by Pulsed Microwave Energy

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Abstract—**A discussion of the production of sound when short microwave pulses are directed at an absorber is presented. Possible mechanisms of the phenomenon are presented. These mechanisms may be important for a better understanding of the so-called microwave "hearing" effect.**

This letter is intended to describe a phenomenon first noticed in our laboratory during some preliminary experiments designed to further elucidate the mechanism(s) responsible for "hearing" pulsed microwave exposure (e.g., [1]–[3]). While attempting to shield portions of the head from RF radiation by using a carbon-impregnated polyurethane microwave absorber (Emerson and Cumming Eccosorb WG4 with a surface area of 3716 cm^2), it was noticed that the apparent locus of the "sound" moved from the observer's head to the absorber. That is, the absorber acted as a transducer from microwave energy to an acoustic signal. This observation, to the best of our knowledge, has not been described in the literature and may serve as an important clue to the mechanism mediating the "hearing" of pulsed microwave signals.

That the signal from the absorber is acoustic is proven by the data presented in Fig. 1 where the ensemble sum of 50 epochs, each 25.6 ms long, is plotted. These data were collected with a General Radio model 1551C sound level meter fitted with a 1560-P5 microphone. The microphone was acoustically coupled to the absorber via one of two cone-shaped guides, 1.42 or 0.73 m long, respectively; these guides were made of construction paper. The recorder output of the sound meter was led through a Krohn-Hite model 3343R bandpass filter (set to pass 150–2500 Hz), to an HP Fourier analyzer model 5451A where the signals were digitized and the 50 epochs were summed at 512 equispaced sample points; the sampling interval was, therefore, 50 μs.

Fig. 1(a) represents one such ensemble sum when the microphone was 1.42 m from the absorber. The sound arrived at, and activated, the microphone approximately 4.68 ms after the trigger pulse was applied to the Applied Microwave Laboratories, Inc., model PG5KB pulse signal source. The output was radiated by a NARDA 646 horn which has a physical aperture of 53.3 $\times$ 39.6 cm. When the distance from the absorber to the microphone was 0.73 m, the sound arrived approximately 3.29 ms after the trigger signal [Fig. 1(b)].

Manuscript received October 29, 1973; revised January 11, 1974.
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