present. The clockwise rule to cover the situation shown in Fig. 1(d) is implemented by connecting the clockwise ac input to the unactivated contact on 1A. If none of the inputs is present, the local clock free runs but can still synchronize its clockwise neighbor.

Description of a dc system was for simplicity of illustration. Other indications of priority could be employed: e.g., tone modulation with tuned reed relays for ac analog systems and simple codes for digital systems.

Point-Contact Wafer Diodes for Use in the 90- to 140-Kilomegacycle Frequency Range

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In millimeter wave systems, one of the most important components is the first converter or mixer. This brief paper describes a recently developed point-contact diode of the wafer type which operates efficiently as a first converter in the frequency range 90 to 140 kilomegacycles (F-band).

Fig. 1 is a photograph of the wafer diode and its holder. The assembly is quite similar in appearance to the diode-holder combination designed for the 45- to 75-kmc range.[1] The tuning procedure is also the same. The wafer is inserted in the holder and moved transversely to the waveguide, thereby adjusting the location of the point-contact relative to the guide to effect a resistive match. (The pin at the left of the wafer slides in a chuck on the inner conductor of the coaxial low-frequency output circuit.) The wafer is then locked in position by means of the knurled clamping knob, and the reactance of the diode is tuned out with the waveguide piston at the rear of the holder.

The present design differs from the older one in the use of smaller waveguide (RG 138/u instead of RG 98/u) and, most importantly, in the addition of the milled slots on either side of the wafer which encompass the rectangular window containing the point-contact diode. When the wafer is inserted in the holder, these slots engage small guiding shoes which automatically align the window of the wafer with the waveguide sections in the holder to better than 0.0005 inch; this accuracy is essential at the extremely high frequency of operation. The method of forming

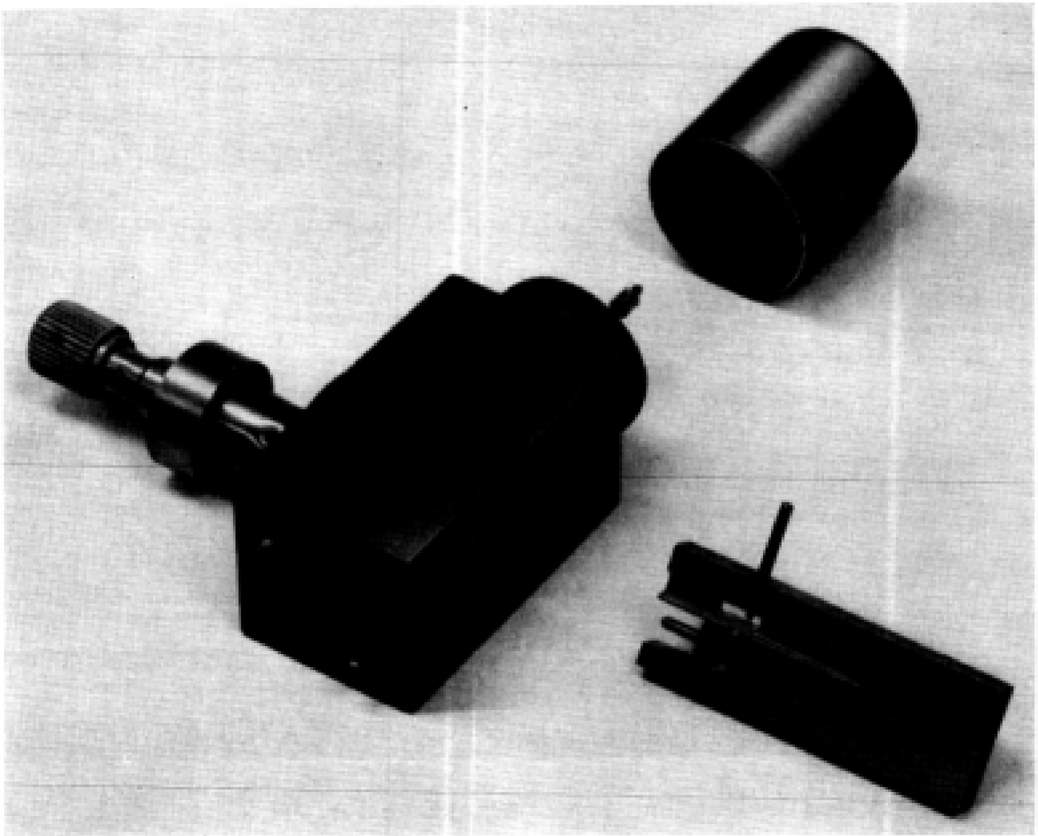

Fig. 1 — Millimeter-wave point-contact wafer diode and holder for use in the 90- to 140-kmc frequency band.

the rectifying junction is also different in the present design. The older units used boron-doped silicon which required that the units be "tapped" into adjustment. The present units use aluminum-doped silicon and do not require tapping. For very high frequency operation, tapping should be avoided if possible since it tends to increase the point-contact area.

The apparatus used to evaluate the diodes is shown in Fig. 2. It constitutes a complete double-detection measuring system. Many of the millimeter wave components shown had to be developed in order to measure the conversion loss of the diodes.

The conversion losses of several types of diodes mounted in the new wafer units are listed in Table I. The measurement consisted of determining the ratio of the millimeter-wave power input to the converter, measured by a calorimeter,[2] to the 60-mc output power measured by comparison with a known signal level obtained from a calibrated signal generator. The conversion loss quoted includes the heat losses of the waveguide input circuits of the diode as well as the losses associated with the output circuitry. The diodes were matched at 115 kmc, were

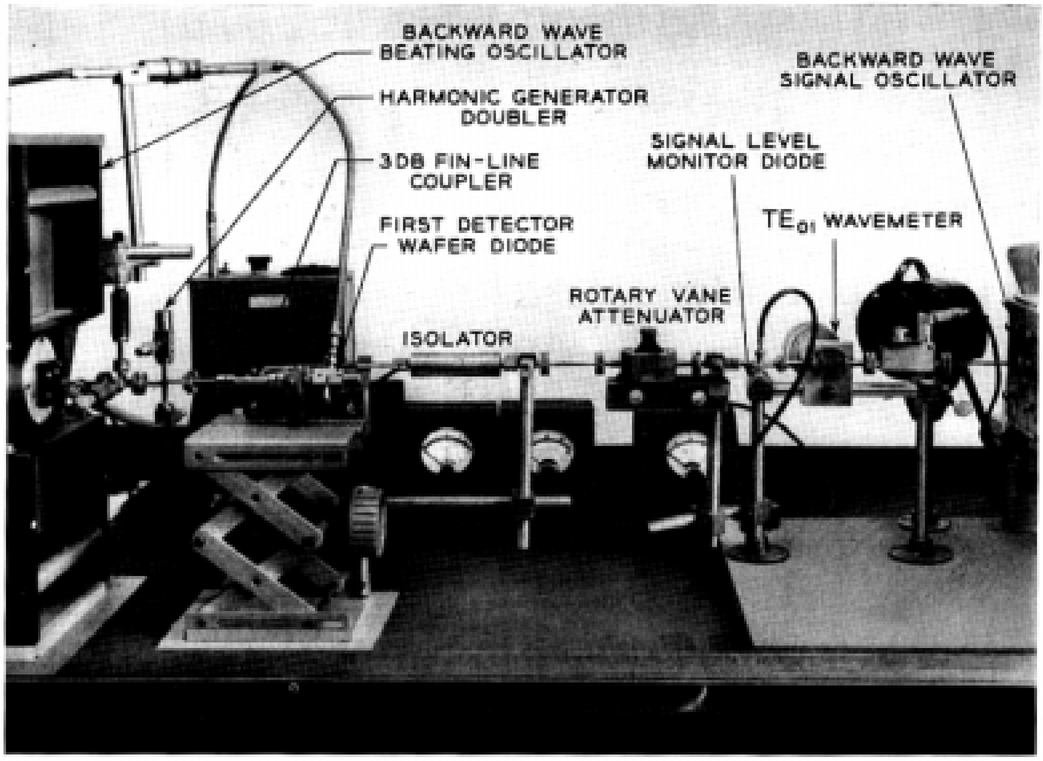

Fig. 2 — A double-detection measuring system for the 90- to 140-kmc frequency band.

optimumly biased, and were driven with 0.6 milliwatt of local oscillator power.

If one assumes a 12-db diode with a noise output ratio, N_R, of 2, which is 30 per cent above the value measured at 55 kmc for similar units, it may be calculated that a balanced converter followed by an IF amplifier with a 4-db noise figure will yield an over-all receiver noise figure of 18 db at 115 kmc. Noise figures very near this value were obtained in practice.

The important contributions of Messrs. E. F. Elbert and S. E. Reed are gratefully acknowledged.

TABLE I — CONVERSION LOSSES

Type of Diode	115-kmc Conversion Loss in db
Average silicon diode (25 units)	12.4
Best silicon diode	11.1
Best gallium arsenide diode	9.9
Best germanium backward diode[3]	11.5

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