

is easily achieved since this "balance" is really required only during low-level operation. Production of PIN diodes can be controlled to match pairs of these devices to good tolerances, relative to their low-level operation. What does become difficult to control is the change of I -layer resistance as a function of input power or dc bias. In this case, however, it is not important since, at high power levels, the only requirement is that no excess power be delivered to the detector.

It can be shown, using the scattering technique, that the reflected power at the input is proportional to the square of the difference between the reflection coefficient of the impedances terminating ports 2 and 3, with $\Gamma_4 = 0$. The return loss, in the case where the PIN diodes capacitance differs by 20 per cent, is 15.9 db corresponding to an input VSWR of 1.38:1, which is a negligible amount.

This device has as its principal advantage the fact that it is capable of retaining its power-limiting properties independent of frequency over extremely wide frequency ranges. As an example, with the proper hybrid design, this device can be made operable over a 10:1 frequency band. Its application would be in many cases where power-limiting is required. Typical of these might be the protection of video crystals from high input power levels. Another application which finds wide use, particularly since the advent of extremely low-noise receivers, is the protection of parametric or maser "front ends." These solid-state devices have a very high susceptibility to high power inputs, so much so that they become completely inoperable, and in some cases permanent damage results. The device described here would protect receivers which use masers or parametric techniques from overloading, while at the same time would not introduce insertion losses which would detract from the over-all receiver performance.

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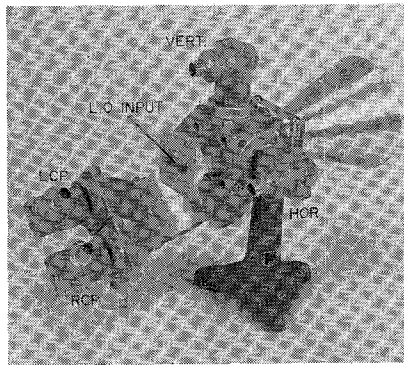


Fig. 1—Four-component polarization resolver for X-band simultaneously provides orthogonal linear and orthogonal CP components of an input signal.

X-band device shown represents an extension of principles applied earlier to an instantaneous polarimeter.¹

In the four-component resolver a trimode turnstile junction is supplemented with a quadrature hybrid junction of the short-slot variety, which for compactness is contained in a 90-degree bend. The device resolves one-half the signal power into orthogonal linear components and the remaining half into orthogonal circular components. Local oscillator drive, injected through the "coaxial" port of the trimode turnstile junction, divides equally among the four mixer crystals. Symmetry of the plumbing insures phase preservation, although at moderate IF's it is not necessary that detector arm lengths be electrically equal.

The device is well adapted to measuring the polarization backscatter characteristics of radar targets, and is currently being employed very successfully in model range polarization studies. When used in an instantaneous polarimeter, the four-component resolver offers advantage over the original polarimeter design¹ in that the "sense" of a polarization pattern being observed is readily indicated by a simple de-

turnstile junction and a quadrature hybrid junction. Auxiliary circuitry was employed for local oscillator injection, although for less critical applications video detectors might be employed on the four ports of the resolver to obtain relative amplitude information for the four different polarizations.

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The Channel Waveguide*

A waveguide propagating the TE₁₀ mode can carry more power than the normal rectangular waveguide if it has a symmetrically placed channel in the E -plane as shown in Fig. 1. The greater height of the channel in the center of the waveguide will allow a higher voltage to be applied before dielectric breakdown occurs. The TE₁₀ cutoff wavelength λ_c was investigated using the methods of Iashkin^{1,2} and Cohn³ to find out if the cutoff wavelength of the channel waveguide was equivalent to that of the rectangular waveguide λ_{cr} .

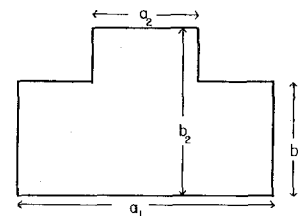


Fig. 1—Basic cross section of the channel waveguide.

An equation derived by Iashkin that fits the cross section in Fig. 1 is

$$\cot K \left(\frac{a_1 - a_2}{2} \right) = \frac{b_1}{b_2} \left\{ \tan K \left(\frac{a_1 - a_2}{2} - \frac{\pi}{2} \right) + 2K \sum_{n=1}^{\infty} \frac{\tanh \sqrt{\left(\frac{n\pi}{b_2} \right)^2 - K^2 \left(\frac{a_1 - a_2}{2} - \frac{\pi}{2} \right)^2} \sin^2 \frac{n\pi b_1}{b_2}}{\sqrt{\left(\frac{n\pi}{b_2} \right)^2 - K^2 \left(\frac{n\pi b_1}{b_2} \right)^2}} \right\} \quad (1)$$

A Four-Component Polarization Resolver*

Numerous ways are known for resolving a polarized microwave signal into pairs of orthogonally polarized components. Although pairs of orthogonal components contain redundant information, in many experimental applications it is desirable to have both linearly polarized and circularly polarized components available for comparison purposes. These four polarization components are derived simultaneously in the simple resolver-mixer assembly of Fig. 1. The

termination of which circularly polarized component is the greater.

A variation of the four-component resolver, recently used in a revealing radar backscatter study,² employs a *conventional*

¹ P. J. Allen and R. D. Tompkins, "An instantaneous microwave polarimeter," *Proc. IRE*, vol. 47, pp. 1231-1237; July, 1959.

² I. D. Olin and F. D. Queen, "Measurements Using A Polarization Instrumentation Radar on Navigational Buoys," U. S. Naval Res. Lab., Washington, D. C., NRL Rept. No. 5701; November, 1961.

where K , the wave number, is equal to λ_{cr}/λ_c and is the only unknown. a_1 is set equal to π and b_1 , b_2 , and a_2 are normalized with respect to π . A restriction on the equa-

* Received by the PGMTT, February 5, 1962.

¹ A. I. Iashkin, "A method of approximate calculation for waveguides of triangular and trapezoidal cross-sections," *Radio Engng.*, vol. 13, pp. 1-9; October, 1958.

² A. I. Iashkin, "The calculation of the fundamental critical wavelength for a rectangular waveguide with longitudinal rectangular channels and ridges," *Radio Engng.*, vol. 13, pp. 8-14; March, 1958.

³ S. B. Cohn, "Properties of ridge waveguides," *Proc. IRE*, vol. 35, pp. 783-788; August, 1947.

* Received by the PGMTT, February 16, 1961; revised manuscript received, January 7, 1962.