Comments* on "Some Notes on Strip Transmission Line and Waveguide Multiplexers"[1]

Use of two tuning screws through the ground planes of a strip-line cavity resonator can excite the parallel plane TEM mode unless both screws are equidistant from the center conductor, rendering this method of tuning quite unattractive. A single tuning screw parallel to and midway between the ground planes is the better way of tuning a stripline cavity resonator.

The implication that a Tchebycheff response shape is preferable to the Butterworth response shape merely on the sole criteria of sharper skirt selectivity is debatable. Butterworth filters are simpler to design, have more favorable phase responses, and are easier to align. Furthermore, Butterworth filters are superior when designing narrow band filters for minimum insertion loss.[2]

We are currently using direct-coupled waveguide resonant cavity filters and have found them to be quite satisfactory. These filters employ five cavity resonators with bandwidths of about 3 per cent in frequency (This corresponds to a filter Q of 33.) Use of quarter-wave coupled cavities would increase over-all filter length by a factor of two, while use of quarter-wave coupled resonant elements would result in intolerable filter insertion losses. It should also be noted that quarter-wave coupled waveguide filters usually employ nominal $\frac{3}{4}\lambda_g$ connecting lines, since use of $\lambda_g/4$ connecting lines and centered inductive coupling posts will cause appreciable higher-mode interaction between adjacent resonators. No general statement can be made concerning the relative merits of direct-coupled and quarter-wave coupled filters. Percentage bandwidth, physical size, construction cost, and other factors must be carefully considered in each specific filter application.

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[1] D. Alstadter and E. O. Houseman, Jr., 1958 WESCON CONVENTION RECORD, pt. 1, pp. 54–69.

[2] J. J. Taub and B. F. Bogner, "Design of three-resonator dissipative band-pass filters having minimum insertion loss," PROC. IRE, vol. 45, pp. 681–687; May, 1957.

The Representation of Impedances with Negative Real Parts in the Projective Chart*

In a previous note [1] the authors considered the representation of active networks in the reflection coefficient chart. The projective chart [2] is obtained from a stereographic projection onto a unit sphere and then from an orthographic projection from the sphere. It is immediately obvious that reflectances whose magnitude is greater than unity will lie within the unit circle of the projective chart. Therefore, each will coincide with another reflectance whose magnitude is less than unity.

From intuitive reasoning it is apparent the reflectances which share the same point in the projective chart are $re^{j\phi}$ and $(1/r)e^{j\phi}$. To show this analytically one determines the hyperbolic distance in the projective chart as proportional to the logarithm of the cross ratio. When the points[1] r and $1/r$ are transformed algebraically, the cross ratios are negatives (but both are real) and the hyperbolic distance of the reflectance whose magnitude is greater than unity is complex. The imaginary component of the distance arises because of the ultra-infinite end point of the measured distance. The real parts of both distances are equal, since the projective chart cannot indicate the j direction which is perpendicular to the plane of the projective chart (they are the same point). This may be seen by using the Riemann sphere as described by Bolinder [3] to visualize that the positive and negative resistance values are on different halves of the sphere and that the orthographic projection is perpendicular to the dividing equator and hence cannot differentiate between real conjugate impedances or reflectances which are inverse with respect to the unit circle. The equivalence between the inverse reflectances can also be seen by constructions in the plane by using the circle of inversion [4]. This leads to a modification of the β transformation of Deschamps which is shown in Fig. 1.

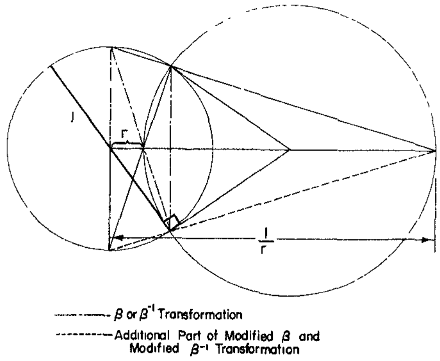

Fig. 1—Modified β and modified β^{-1} transformation.

Therefore, it is seen that the projective chart can be used to represent active networks by using the points of the real conjugate of the impedance or the reflectance that is inverse with respect to the unit circle.

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[4] J. de Buhr, "Eine neue methode zur bearbeitung linearer vierpole," *FTZ-Fernmeldetech Z.*, vol. 8, pp. 200–204, April, 1955; pp. 335–340; June, 1955.

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[1] The phase angle ϕ will not affect the distance from the center.

Design Calculations for UHF Ferrite Circulators*

The recent advances in low-noise amplifier work for communications systems has created an additional demand for circulators; in this case, to prevent receiver noise from returning to the low-noise amplifier. In the range of frequencies greater than 2000 mc, ferrite circulators have been developed in circular and rectangular waveguides. However, in the UHF region, which is a range of frequencies of increasing interest and importance in communications, ferrite circulators present a problem in the sense that ordinary waveguides needed in this range are prohibitively large for practical use. Button[1] of Lincoln Laboratory and Seidel[2] of Bell Telephone Laboratories have pointed a way around this difficulty by considering a TEM structure (a coax) loaded antisymmetrically with dielectric material and ferrite. This configuration provides for the longitudinal component of RF magnetic field necessary for nonreciprocity in the phase constant.[2] The essentially TEM nature of the device allows use of reasonably small, practical cross-sectional areas. The parallel-plate analog analysis presented in Button's paper leads to a transcendental equation for the phase constant which we present below for convenience, together with an example of the structure (see Fig. 1).

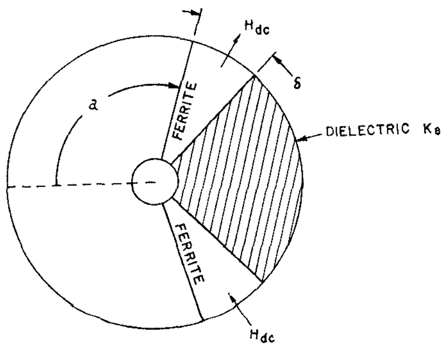

Fig. 1—Cross section of coaxial phase shifter.

* Received by the PGMTT, May 4, 1959.

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