uniform. Also, the sample must be sufficiently small that there are no "retardation" or propagation effects within the sample. The propagation constant within the sample can be calculated from its dielectric constant and taking its permeability as -2. [See (2).] Tompkins and Spencer have derived a formula to take sample size into account.[10] Their formula when expanded in a Taylor series, becomes

$$\frac{\Delta F}{F} = A \frac{(\mu_i - 1)\left(1 - \frac{X^2}{10}\right)}{(\mu_i + 2) - X^2\left(\frac{\mu_i - 1}{10} + \frac{1}{2}\right)} \cdot \quad (3)$$

$X = 2\pi r/\lambda_0\sqrt{2\epsilon'}$ where r is the radius of the sample, ϵ' is the real part of the dielectric constant of the ferrite (approximately 10), amd λ_0 is the free space wavelength. According to this equation, the error in gyromagnetic ratio measured at 3000 megacycles for a sample diameter of 0.240 inch, or at 9000 megacycles for a sample diameter of 0.080 inch, will be about two per cent. The error in line width is comparable.

Spencer *et al.* give experimental data to show that the line width of $R-1$ measured at X band is independent of sample size for diameters ranging from 25 to 60 mils.[11] Stinson shows that the line width of polycrystalline YIG measured at X band is independent of sample size for diameters ranging from 40 to 90 mils.[12] Stinson attributes the independence of sample diameter to his use of a cross-guide coupler instead of a resonant cavity, and refers to an article by Artman to show that sample size has a strong effect on measurement of line width when a cavity is used.[13] However, as noted above, Tompkins and Spencer have derived an equation for measurement in a cavity which shows only a very small dependence on diameter for the range of diameters covered by Stinson. Tompkins and Spencer discuss the discrepancy between their equation and that of Artman, and this writer believes that Tompkins and Spencer are correct.

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[12] D. C. Stinson, "Experimental techniques in measuring ferrite line widths with a cross-guide coupler," 1958 WESCON Convention Record, pt. 1, pp. 147–150.

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Plotting Impedances with Negative Resistive Components*

The plotting of impedances with negative resistive components on some sort of inverted Smith chart is becoming more common.[1] This note suggests standardizing on a particular form, for psychological reasons. The suggested form is represented by "Γ" $= -1/\Gamma$, where Γ is the actual complex reflection coefficient, and "Γ" is the value plotted on the chart. The corresponding impedance relation is "Z/Z_0" $= -Z_0/Z$. The advantages claimed for this particular form are:

1) The transformation is analytic as opposed to the one mentioned by Stock and Kaplan.[1]

2) If both negative and positive resistances are being plotted on two Smith charts, the result, as shown in Fig. 1, looks like the representation of the world on the covers of some atlases. It fits well with the concept of projection on the unit sphere.

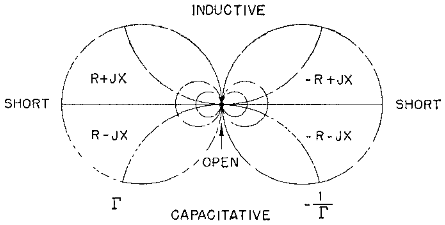

Fig. 1—Double SMITH-HTIMS chart.

3) It follows from 1) that if impedance is being plotted as a function of real frequency, then points of stability or instability as indicated by complex frequency will fall on the same side of the curve on both charts.

A possible disadvantage is the opposite sense of rotation of the two charts for transmission-line calculations, but this seems natural and easy to remember for two circles in "contact."

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Comments on "The Design of Ridged Waveguide"*

An article by Hopfer,[1] which appeared in 1955, takes into account the step discontinuity susceptance in the computation of the cutoff frequencies of ridged-waveguide. Cutoff frequencies are computed utilizing the transverse resonance method. Values of the normalized step susceptance that were used in computing the cutoff frequencies were taken from published data in the Waveguide Handbook.[2]

It seems that this procedure for determining the step susceptance is questionable. The transverse resonance method as applicable to ridged waveguide entails computing the circuit parameters of parallel plane transmission lines. Consequently, the step discontinuity susceptance should be computed as a step in a parallel plane transmission line[3,4] rather than as a step in rectangular waveguide.

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* Received by the PGMTT, January 18, 1960.

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[2] N. Marcuvitz, "Waveguide Handbook," M.I.T. Rad. Lab. Ser., McGraw-Hill Book Co., Inc., New York, N. Y., vol. 10, pp. 399–402; 1951.

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[4] J. R. Whinnery and H. W. Jamieson, "Equivalent circuits for discontinuities in transmission lines," Proc. IRE, vol. 32, pp. 98–116; February, 1944.