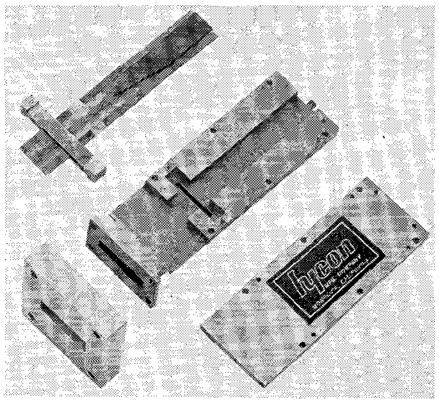

Fig. 1—Miniature strip-line to waveguide slot adapter—inline.

TABLE

Center Frequency (GC)	Bandwidth for VSWR ≤1.20 (Mc)	Bandwidth for VSWR ≤1.20 (per cent)	Data Plotted on Fig. 2
9.0	960	10	Curve 1
9.4	780	8	Curve 2
9.8	1180	12	Curve 3
10.2	700	7	Curve 4

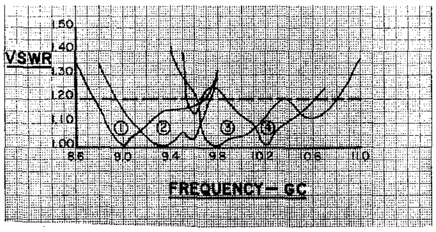

Fig. 2—Input VSWR vs frequency.

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Addendum to "Discontinuities in the Center Conductor of Symmetric Strip Transmission Line"*

It has been pointed out to the authors that the formulas contained in their paper[1] refer only to air-filled and not to dielectric-filled strip transmission lines. This is indeed the case and constitutes an omission which is now rectified by sketching the simple extension to the dielectric-filled case.

All formulas in the paper, save that for the characteristic impedance, remain completely unaltered in the dielectric-filled case provided λ is understood to denote the wavelength in the dielectric-filled strip-line; *i.e.*, $\lambda = \lambda_0/\sqrt{\epsilon'}$, where λ_0 is in air-filled strip-line and $\sqrt{\epsilon'}$ is the relative dielectric constant. In dielectric-filled line κ then is $2\pi/\lambda$. In the dielectric case, the characteristic impedance Z_0 must be computed from

$$Z_0 = \frac{1}{\sqrt{\epsilon'}} \frac{30\left(1 - \frac{t}{b}\right)}{D/b}.$$

It should be kept in mind that the results for normalized reactance and susceptance network elements, such as X_a' or B_b', are now normalized with respect to Z_0 (or $Y_0 = 1/Z_0$) as just defined. The equivalent strip width D and other equivalent dimensions do not depend on the dielectric constant.

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[1] H. M. Altschuler and A. A. Oliner, "Discontinuities in the center conductor of symmetric transmission line," IRE TRANS. ON MICROWAVE THEORY AND TECHNIQUES, vol. MTT-8, pp. 328–339; May, 1960.

A Simple Method for Measuring the Phase Shift and Attenuation through Active Microwave Networks*

Most methods used to measure the phase shift and attenuation through a microwave network require that the network be matched to the waveguide or the VSWR must be measured. In passive networks, these are simple and straightforward operations. However, in some active networks, principally networks which are time/temperature dependent, these operations become very tedious and time consuming. The method illustrated here can measure the phase shift and attenuation simultaneously, directly, independently, eliminates the inconvenience of measuring the VSWR, or matching the network to the waveguide and consists of generally available microwave equipment.

The physical setup consists of a conventional phase-shift loop (interferometer) and a loosely coupled "attenuation" loop. The loops are illustrated in Fig. 1.

The function of the attenuation loop is to take into account the reflected power so that the attenuation of the unknown network may be read directly.

The loop accomplishes this by adding, in phase, part of the power output and part of the power reflected by the unknown network. The sum of these powers will remain constant unless there is attenuation by the network. When attenuation occurs, it will appear as a decrease in the sum of the reflected power and the power output of the network. The attenuation of the network may then be directly read by increasing the power input to the attenuation loop until the original sum is reached. The reflections may occur at any discontinuity or set of discontinuities in the network; therefore, an adjustable phase shifter capable of 360° phase shift must be employed (in either arm of the attenuation loop) and tuned for detector maximum in the attenuation loop for each attenuation measurement. The directional couplers (20 db or more) must be balanced or some attenuation must be added to the more tightly coupled coupler in order to maintain the accuracy of the system. The system may be checked out by inserting an adjustable short in the output (at point A) of the network and insuring that there is only very small variation in the output at the attenuation loop detector. Care must be taken to insure that the network is not radiating as this method will not take radiation into account. The attenuation of the network is read directly by the calibrated attenuator external to the loops.

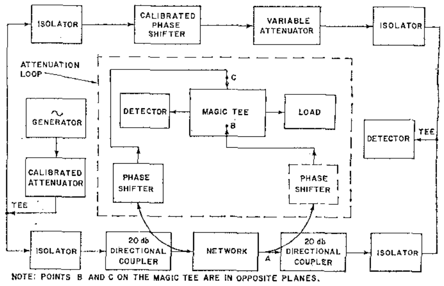

Fig. 1—Phase shift and attenuation loops.

With an X-band power source of 10 mw the dynamic range is approximately 20 db. If greater range is needed, low-noise microwave amplifiers may be used in place of the crystal detectors or the power source may be increased.

This method is currently being used to measure phase shift and attenuation through gas discharge tubes at X-band and it has greatly simplified these measurements.

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Design of Interstage Coupling Apertures for Narrow-Band Tunable Coaxial Band-Pass Filters*

The design technique to be described in this note is applicable to tunable coaxial band-pass filters having narrow bandwidths (*i.e.*, less than 10 per cent). In the frequency range of 1500 Mc to about 10,000 Mc, coaxial band-pass filters usually employ coupled $\lambda/4$ resonant cavities. Unlike direct coupled waveguide band-pass filters which are often amenable to a complete paper design,[1] these coaxial band-pass filters require

* Received by the PGMTT, November 27, 1961.

[1] S. B. Cohn, "Direct-coupled resonator band-pass filters," PROC. IRE, vol. 45, pp. 187–195; February, 1957.