APPLICATION OF SLOT LINE TO MINIATURE FERRITE DEVICES*

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Slot transmission line was introduced by S. B. Cohn[1] in 1968 as an alternative transmission line for microminiature components. Slot line is potentially advantageous when compared to other planar transmission lines for applications requiring regions of circularly polarized magnetic field and/or shunt mounted elements. The line consists of two conductors separated by a gap on one side of a dielectric substrate. The dominant mode is a TE mode as shown in Figure 1. This mode resembles the dominant mode of rectangular waveguide and provides natural regions of circularly polarized magnetic field. Slot line applications will include ferrite phasers, circulators and isolators, diode switches and phasers, and filters. Combined microstrip and slot line circuitry seem to offer new possibilities for systems with the advantage of coupling easily through the substrate from one medium to the other.

The basic transmission parameters of slot line have been investigated experimentally. Measurements were made on lightly coupled resonant line sections. A digital computer reduced the measured data to phase and attenuation constants. Some experimental slot line parameters are given in Figures 2, 3, and 4. Phase constant as a function of frequency is shown in Figure 2. These data illustrate the dispersion of slot line and compare slot line wavelength to that of 50 ohm microstrip and TEM line of like dielectric constant. Figure 3 presents phase constant as a function of substrate thickness with frequency as a parameter and shows more clearly the effect of substrate thickness. The attenuation constant of various slot transmission lines is compared to 50 ohm microstrip in Figure 4 and is seen to be very similar. Experimental results correlate closely with recent theoretical calculations by Cohn.[2]

Both coax and microstrip transitions to slot line have been designed and tested. Typical transitions are shown in Figures 5 and 6. Design and matching of the microstrip transition has been carried out with the aid of a digital computer program. The coax

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NOTES

transition exhibited VSWR better than 1.14 from 4 GHz to 6 GHz, and is expected to give good, broadband performance. The microstrip transition is projected to give 15-20% bandwidth with VSWR under 1.10.

Preliminary ferrimagnetic phase shift investigations have achieved a differential phase shift of 60 degrees per inch. Higher phase shift is expected as the investigation continues.

The paper will discuss basic slot line parameters with additional information regarding the effect of conductor width, dielectric constant, etc. Data on transitions and devices mentioned above will be included as well as available data on other components such as thin film terminations, isolators, circulators, resonators and filters. In addition, appropriate theoretical analysis will be included.

References:

1. Cohn, S.B., "Slot Line - An Alternative Transmission Medium for Integrated Circuits," G-MTT Symposium, 1968.

2. Cohn, S.B., Private communication.

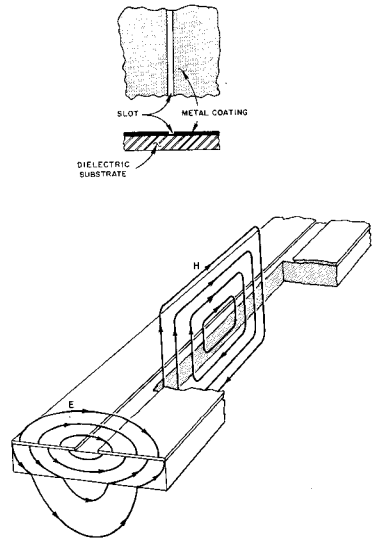

Fig. 1. Slot Line - Dominant Mode.

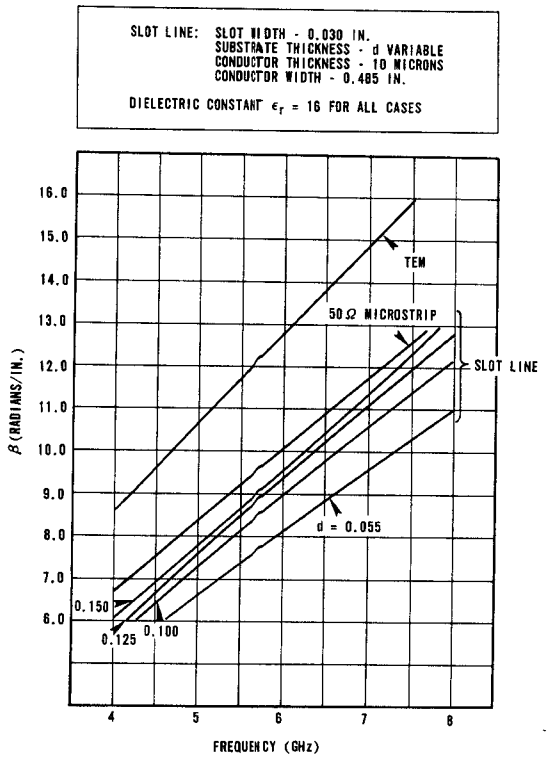

Fig. 2. β vs. Frequency - Substrate Thickness as Parameter (with comparison to 50 ohm microstrip and TEM line).

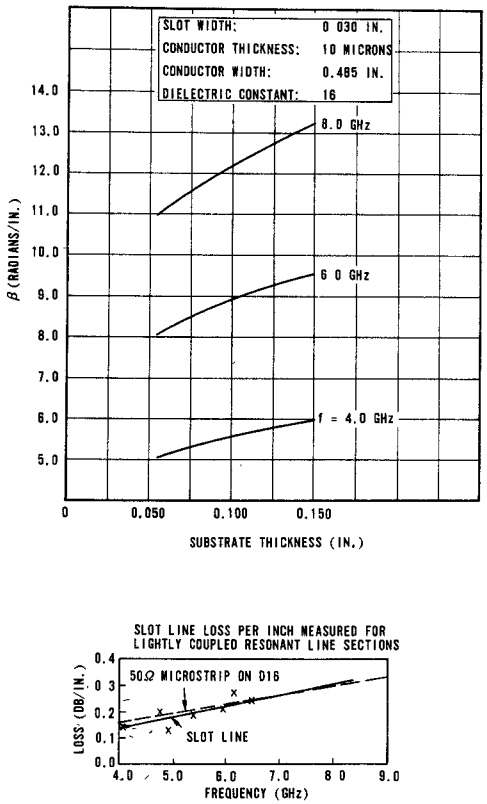

Fig. 3. β vs. Substrate Thickness Frequency as Parameter

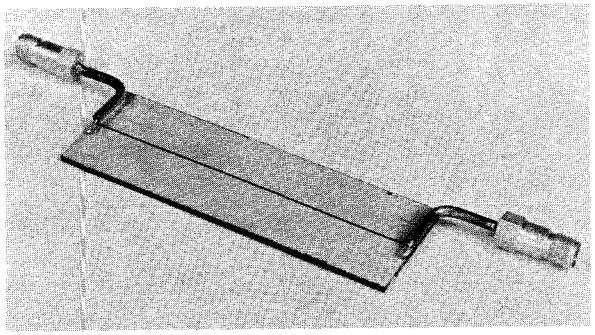

Fig. 5. Coax - Slot Line Transition

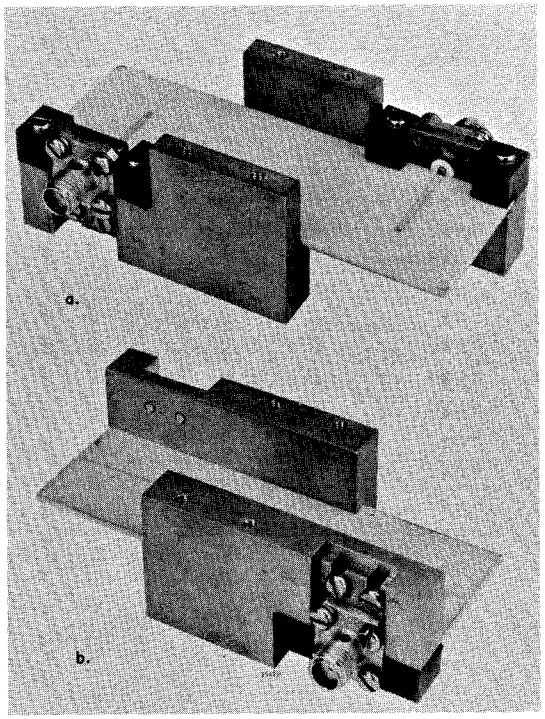

Fig. 6. Microstrip - Slot Line Transition