results from the imperfect cancellation occurring at the junctions which is due to construction tolerances and discontinuity capacity.

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Broadbanding Microwave Diode Switches

In the design of microwave switching networks, it is often necessary to design for minimum VSWR and low loss over a broadband. One class of PIN diode TEM microwave switch may be successfully broadbanded by utilizing the band-pass filter designs published by Mumford [1] and Matthaei [2].

Consider the S.P.D.T. diode switch in Fig. 1 which uses two pairs of PIN diodes shunting a TEM stripline circuit. (Diodes must be paired in stripline circuits to obtain maximum forward bias attenuation.) If the diodes in "diode gate" D' are forward biased and the diodes in D are reverse biased, then most of the incident generator power will flow to G_L and vice versa. The canonical form of the Fig. 1 switch in either condition is a four "stub" band-pass filter consisting of $\lambda_0/4$ shunt stubs of characteristic admittance Y_m separated by quarter wave lengths of connecting line with characteristic admittance $Y_{m,m+1}$. For the condition where generator power flows to G_L, the first stub is Y_1, the second is $Y_2=Y_{23}'$, the third "stub" (normally denoted by Y_3) is the parallel resonant circuit at D obtained by tuning out the diodes' reverse biasc apacitance with the short inductive stub Y_α, and the fourth is Y_4. The filter will exhibit maximally flat or Tschebyscheff band-pass response if certain prescribed values of characteristic admittance are assigned to Y_m and $Y_{m,m+1}$.

The problem arises as to what value of equivalent quarter wave stub characteristic admittance (Y_3) one must assign to the D and Y_α resonant circuit. This is properly called a "quasi-lumped" stub, since the inductive stub Y_α is loaded by the lumped capacitance of D. One method, found to give good practical results, is to equate the mid-band susceptance slope of the quasi-lumped stub to that of an actual $\lambda_0/4$ stub of characteristic admittance Y_3. This may be done by considering Fig. 2, where

$$B = j\omega C - jY_\alpha \cot \frac{\omega d_\alpha}{V}$$

where

$$V = \frac{3 \times 10^8}{\sqrt{\epsilon_r}} \text{ meters/s}$$

$$\frac{dB}{d\omega} = j\left(C + Y_\alpha \frac{d_\alpha}{V} \csc^2 \frac{\omega d_\alpha}{V}\right).$$

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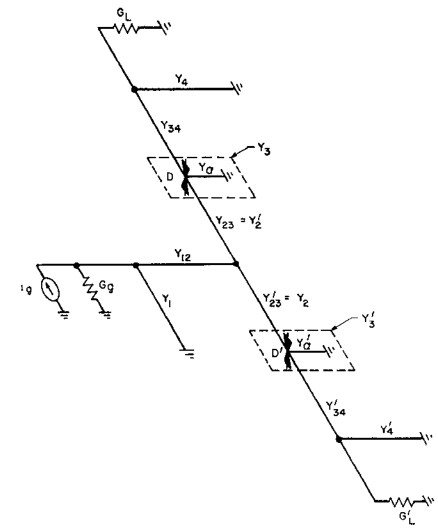

Fig. 1. Schematic diagram of stripline S.P.D.T. diode switch.

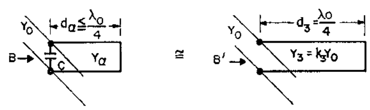

Fig. 2. Quasi-lumped stub and equivalent quarter-wave stub.

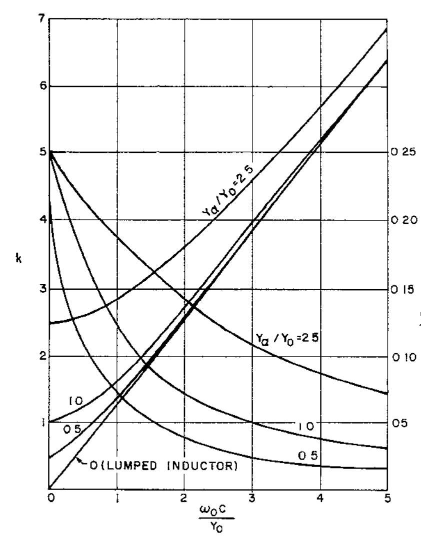

Fig. 3. Equivalent k of quasi-lumped stub (positive slope curves) and length d_α of quasi-lumped stub (negative slope curves), all vs. $\omega_0 C/Y_0$.

Also, for the quarter wave stub

$$B' = -jY_3 \cot \frac{\omega d_3}{V}$$

$$\frac{dB'}{d\omega} = jY_3 \frac{d_3}{V} \csc^2 \frac{\omega d_3}{V}.$$

Equating the two derivatives since we wish the selectivities to be equal near ω_0.

$$C + Y_\alpha \frac{d_\alpha}{V} \csc^2 \frac{\omega d_\alpha}{V} = Y_3 \frac{d_3}{V} \csc^2 \frac{\omega d_3}{V};$$

let

$$\omega = \omega_0, \qquad d_3 = \frac{\lambda_0}{4} \qquad k_3 = \frac{Y_3}{Y_0}:$$

then

$$\csc^2 \frac{\omega_0 d_3}{V} = 1$$

and

$$k_3 = \frac{4}{\pi} \cdot \frac{\omega_0 C}{2Y_0} + \frac{4}{\pi} \cdot \frac{\omega_0 d_\alpha}{2V} \cdot \frac{Y_\alpha}{Y_0} \csc^2 \frac{\omega_0 d_\alpha}{V};$$

also for $B=0$ at $\omega=\omega_0$

$$\omega_0 C = Y_\alpha \cot \frac{\omega_0 d_\alpha}{V}$$

whence

$$k_3 = \frac{2}{\pi Y_0}\left\{\omega_0 C + Y_\alpha \left[\operatorname{arc\,cot} \frac{\omega_0 C}{Y_\alpha}\right] \cdot \left[1 + \left(\frac{\omega_0 C}{Y_\alpha}\right)^2\right]\right\}. \quad (1)$$

k_3 may be considered as the normalized characteristic admittance of the equivalent quarter wave stub Y_3. Figure 3 plots k vs $\omega_0 C/Y_0$ for various values of Y_α, and may be used for designing a switch or any other bandpass structure with one or more quasi-lumped stubs.

One further constraint faces the designer of the Fig. 1 switch: for a symmetrical configuration (through this is not necessary) $Y_{23}=Y_{23}'$, and when Y_{23} is being used as a coupling line, Y_{23}' must serve as a shorted stub, and vice versa. Hence, the filter design equations must be examined to find if any cases exist where $Y_{23}=Y_{23}'$. In this respect Mumford's [1] equations for maximally flat filters are particularly useful since they have the constraint that $Y_{m',m+1}=Y_0$ for all cases. Therefore, the designer need only choose the case where $Y_{23}=Y_{23}'=Y_0$. Then, for the 4-stub filter $Y_3=Y_0$ and $Y_1=Y_4$. However, if the designer must use a diode capacitance C such that $Y_3>Y_0$, then he should build a filter with an odd number of sections, and place D in the center since for maximally flat filters the center stub always has the highest characteristic admittance.

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Organic Superconductor and Dielectric Infrared Waveguide, Resonator, and Antenna Models of Insects' Sensory Organs

With reference to Little's recent paper [1], the following comments may be of value:

Nature may have long ago discovered the facts concerning the feasibility of organic

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