Measurements of Intercavity Couplings

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The concept of determining intercavity couplings from frequency measurements used in the short paper by Atia and Williams [1] was described for the case of coupling between two cavities in [2], which was referred to and portions summarized in [3]. A variation of that technique which the author has found useful for rapidly measuring the coupling between adjacent resonators in VHF filters is as follows.

When a small probe or loop is inserted into one cavity of a coupled cavity pair, with all external loading removed and any other coupled cavities detuned, the probe impedance locus is as shown in Fig. 1, provided that the coefficient of coupling K (or M_{12}) is greater than $1/Q_{II}$ where Q_{II} is the unloaded Q of the second cavity [2]. In Fig. 1 the circle represents the outer limits of the Smith Chart and the straight line represents the resistive axis. Depending on whether a probe or loop is used, the locus goes to either an open circuit or short circuit off resonance.

The coefficient of coupling K or M_{12} is given by

$$K = \left[\left(\frac{\delta f_K}{f_0}\right)^2 + \left(\frac{1}{Q_{II}}\right)^2\right]^{1/2} \tag{1}$$

where δf_K is the difference between the frequencies at which the locus passes through the common point T, and f_0 is the center or cavity-resonant frequency [2]. The effect of varying the probe or loop insertion is to change the reference impedance level, and it is possible to make the crossover point T as viewed on a network analyzer coincide with the center of the Smith Chart (perfect match). Therefore a simple reflection coefficient bridge can be used instead of a network analyzer, and the probe or loop coupling adjusted for a swept frequency bridge output display as shown in Fig. 2.

A measurement of the frequency separation between the two cases of perfect match (zero bridge output) gives δf_K. Usually Q_{II} is known approximately but its effect on the calculation of K from (1) is small. For example, even neglecting the contribution of Q_{II} completely by use of the approximation

$$K = M_{12} \approx \frac{\delta f_K}{f_0}$$

gives less than 2-percent error if $K > 5/Q_{II}$.

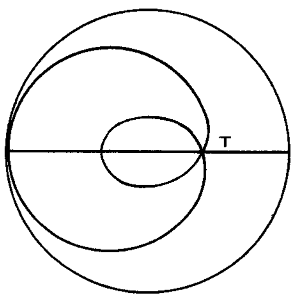

Fig. 1. Impedance locus.

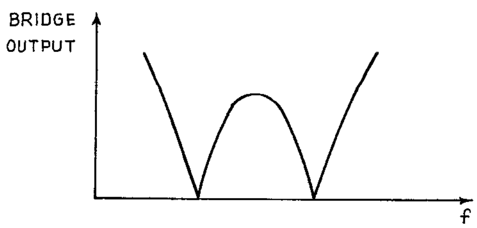

Fig. 2. Swept frequency bridge output.

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[2] N. A. McDonald, "Electromagnetic coupling through small apertures," Elec. Eng. Dep., Univ. Toronto, Toronto, Ont., Canada, Res. Rep. 45, 1971.

[3] ——, "Electric and magnetic coupling through small apertures in shield walls of any thickness," *IEEE Trans. Microwave Theory Tech.*, vol. MTT-20, pp. 689–695, Oct. 1972.

Correction to "Temperature-Stabilized 1.7-GHz Broad-Band Lumped-Element Circulator"

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In the above paper,[1] on page 691, from the duality relationship [1], (12) and (13) should read

$$\mu_{\pm \text{eff}} = \frac{r}{1 - q_m + \dfrac{q_m}{\mu_\pm}} + \frac{1 - r}{1 - q_m + \dfrac{q_m}{\mu}}$$

$$\mu_{i\ \text{eff}} = \frac{1}{1 - q_m + \dfrac{q_m}{\mu}}.$$

Nonreciprocal filling factor k_f, which is given by ratio of $(\mu_{+\text{eff}} - \mu_{-\text{eff}})/(\mu_+ - \mu_-)$, becomes

$$k_f = \frac{q_m r}{1 + \dfrac{2\sigma P(1 - q_m)}{\sigma^2 - 1} + \dfrac{P^2(1 - q_m)^2}{\sigma^2 - 1}}.$$

However, it can be assumed in the usual below-resonance circulators that $\sigma \approx 0$ and $P(1 - q_m) < 1$. Thus (7) and (14) hold as the following approximate equations:

$$k_f \approx q_m r$$

$$\mu_{\pm \text{eff}} \approx 1 \mp k_f P.$$

In the above paper,[1] on page 690 in (3), capacitance $12C_c$ should

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[1] H. Katoh, *IEEE Trans. Microwave Theory Tech.*, vol. MTT-23, pp. 689–696, Aug. 1975.

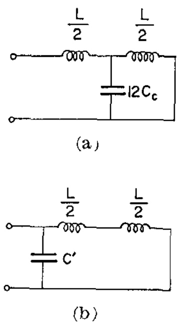

Fig. 1. Equivalent circuit of junction inductor.

read $3C_c$. Using the Δ–Y transformation, crossover capacitances can be transformed into shunt capacitance $12C_c$ which is located nearly in the middle of each junction inductor, as shown in Fig. 1(a). Equivalent terminal capacitance C' in the circuit of Fig. 1(b), which has equivalent impedance to the circuit of Fig. 1(a), is approximately given as $(12/4)C_c$ under the assumption that $\omega^2 3C_cL \ll 1$.

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[1] R. A. Pucel and Massé, "Microstrip propagation on magnetic substrates—Part I Design theory," *IEEE Trans. Microwave Theory Tech.*, vol. MTT-20, pp. 304–308, May 1972.

Corrections to "High-Power Pulsed UHF and L Band p^+-n-n^+ Silicon TRAPATT Diode Lasers"

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In the above paper,[1] the last word in the title of the paper is incorrect. The correct title should read as follows: High-Power Pulsed UHF and L Band p^+-n-n^+ Silicon TRAPATT Diode Oscillators.

The third sentence of paragraph one of the Introduction on page 959 should read: In addition, small size, low cost, and high-quality spectral output are some of the prime circuit and device design requirements.

The last sentence of the second paragraph of Section IV on page 962 should read: Significantly too, the frequency of oscillation increases more slowly in the region of constant optimum voltage collapse ratio than in the other regions, strengthening the conjecture that optimum diode–external circuit interaction conditions exist in that region.

The date for [12] on page 969 should read: May 1973.

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[1] C. O. G. Obah *et al.*, *IEEE Trans. Microwave Theory Tech.*, vol. MTT-23, pp. 959–970, Dec. 1975.