REFERENCES

[1] A. J. Seeds and J. R. Forrest, "Initial observations of optical injection locking of an X-band IMPATT oscillator," *Electron Lett.*, vol. 14, pp. 829–830, Dec. 1978.

[2] J. R. Forrest and A. J. Seeds, "Analysis of the optically controlled IMPATT (OPCAD) oscillator," *Inst. Elec Eng. J Solid-State and Electron Devices*, vol. 3, pp. 161–169, Sept. 1979.

[3] H. W. Yen, "Optical injection locking of Si IMPATT oscillators," *Appl. Phys Lett.*, vol 36, pp. 680–683, Apr. 1980.

[4] P. Weissglass, "Avalanche and barrier injection devices," in *Microwave Devices*, M. J Howes and D. V. Morgan, Eds. Chichester: Wiley, 1976, pp. 79–87.

Further Comments on "Integration Method of Measuring Q of the Microwave Resonators"

P. L. OVERFELT AND D. J. WHITE

In reply to our comments [1] concerning his paper,[1] I. Kneppo showed an exact integration of the expression

$$P(\omega) = P_0\left[1 + Q_L^2(\omega/\omega_0 - \omega_0/\omega)^2\right]^{-1} \tag{1}$$

between the limits ω_1 and ω_2 by the substitution of variables, $x = \omega/\omega_0 - \omega_0/\omega$, and a simplifying choice of limits symmetrical in x

$$I = \int_{\omega_1}^{\omega_2} P(\omega)\,d\omega = P_0\omega_0 Q_L^{-1}\tan^{-1}\left(Q_L\omega_2\omega_0^{-1}\right). \tag{2}$$

Limits symmetrical about $x = 0$ amount to the condition

$$\omega_1\omega_2 = \omega_0^2 \tag{3}$$

and when this relation holds, (2) is exact as may be verified by substituting (3) into the general expression for I, regardless of integration limits

$$I = \frac{P_0\omega_0}{2Q_L}\left\{\tan^{-1}\left[\omega_0 Q_L \frac{\omega_2(\omega_0^2 - \omega_1^2) - \omega_1(\omega_0^2 - \omega_2^2)}{(\omega_0^2 - \omega_1^2)(\omega_0^2 - \omega_2^2)Q_L^2 + \omega_1\omega_2\omega_0^2}\right] - 2\frac{1}{\sqrt{4Q^2 - 1}}\ln\left[\frac{(\omega_0^2 + \omega_2^2)Q_L + \omega_2\omega_0\sqrt{4Q_L^2 - 1}}{(\omega_0^2 + \omega_2^2)Q_L - \omega_2\omega_0\sqrt{4Q_L^2 - 1}} \cdot \frac{(\omega_0^2 + \omega_1^2)Q_L - \omega_1\omega_0\sqrt{4Q_L^2 - 1}}{(\omega_2^2 + \omega_1^2)Q_L + \omega_1\omega_0\sqrt{4Q_L^2 - 1}}\right]\right\} \tag{4}$$

and using the identity

$$2\tan^{-1} a = \tan^{-1}\frac{2a}{1 - a^2}. \tag{5}$$

We had assumed [1] integration limits symmetrical in ω_0

$$\omega_1 = \omega_0 - \omega_s/2$$
$$\omega_2 = \omega_0 + \omega_s/2 \tag{6}$$

rather than x, but this does not account for the difference between our results and Kneppo's for typical microwave cavities.

Unfortunately, (7) in [1] omitted the square on Q_L in the denominator of the $\tan^{-1}$ term, this equation being otherwise identical to (4) of this note. Thus, our approximations for the case $Q_L \gg 1$, $\omega_0 \gg \omega_s$ were in error. When (6) is substituted in (4), given these conditions, Kneppo's (2) results.

It follows that (8) and (9) in our comments [1] are in error and that (10) should read

$$I = 2\pi P_0 \Delta f \tan^{-1} k. \tag{7}$$

In any case, the method of integrating (1) between general limits is of much interest, and (4) does allow asymmetrical limits for experimental integration. For example, integrating between the 3-dB and the resonant frequencies (setting ω_1 or ω_2 equal to ω_0) gives

$$\frac{I}{P_0} = \frac{\pi^2\Delta f}{4} \tag{8}$$

where Δf is the 3-dB bandwidth. This expression should allow a check on the symmetry of the resonance curve and, hence, show how good a description of the cavity resonance (1) actually is.

REFERENCES

[1] P. L. Overfelt and D. J. White, "Comments on 'Integration method of measuring Q of the microwave resonators'," *IEEE Trans Microwave Theory Tech.*, vol. MTT-31, pp. 502–504, June 1983.

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[1] I. Kneppo, *IEEE Trans. Microwave Theory Tech*, vol. MTT-31, Feb 1978.

Comments on "New Narrow-Band Dual-Mode Bandstop Waveguide Filters"

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I have read the above paper[1] with interest, but find some possible discrepancies between the data presented in Fig. 4 and the data presented in Fig. 6. It seems to me that the data in Fig. 4 is probably accurate, reflecting as it does the rejection obtainable through a single pair of ports coupling to a dominant mode propagating waveguide. No matter how the multiple pole filter is synthesized in the concept discussed by the authors, the shunt coupled bandpass filter is coupled only by a pair of couplings to the main line. Thus, the limitation on the depth of the obtainable rejection is determined by two factors: 1) orthogonality of the two coupling irises, and 2) return loss of the two coupling irises.

The data of Fig. 6 implies an input return loss for the bandpass filter and a value for the coupling iris isolation of over 50 dB, values which do not seem very likely. The data of Fig. 4 shows

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[1] J.-R. Qian and W.-C. Zhuang, *IEEE Trans Microwave Theory Tech.*, vol. MTT-31, pp. 1045–1050, Dec. 1983

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