GENERAL RADIO COMPANY

engineering department

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DESIGN CURVES FOR QUARTER-WAVE RESONATORS WITH CAPACITANCE LOADING

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With the increasing availability of transistors and varactors for use in oscillators and frequency multipliers in the VHF and UHF range, the quarter-wave resonator is becoming more popular.

Figure 1 shows a typical resonator and some of the different forms of coupling used. Parallel and strip-line techniques are often used as well as cylindrical and rectangular coaxial lines.

To enable precise tuning, or to cover a range of frequencies, the center conductor is made shorter than a quarter wavelength and capacitance loading is used at the open end. The capacitance is chosen such that its reactance equals the inductive reactance of the line at the desired frequency. The tuning equation is:

$$1/2\,\pi\, fc = Z_o \tan 2\,\pi\, fl/v_c$$

The unloaded Q of the resonator is a maximum when $Z_o = 76.7$ ohms ($D/d = 3.59$). Because of the tangent term, tabular techniques must be used to plot the relation between c, f, and *l*. The equation was manipulated into the form shown in Figure 2, and a digital computer yielded points to plot the curves.

These curves can be used to estimate the value of capacitance required to tune a given length line to a given frequency, or to determine the proper length line to cover a desired range of frequencies with a given capacitance variation. The curves show, for example, that a 6 cm line can be tuned from 100 to 1000 MHz with a capacitance variation of 0.66 to 160 pF, or that 2.4 pF are required to tune a 10 cm line to 500 MHz.

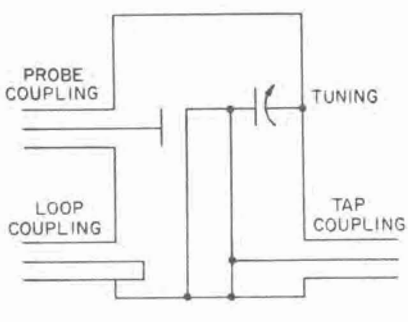

Figure 1 — Quarter-wave resonator.

BIBLIOGRAPHY

1. Schaffner, G., "A New Look at Coaxial Cavities for Varactor Multipliers," *Electronics,* May 17, 1965, pp. 56-64.
2. Schumacher, H. L., "Direct Coupled Ganged Tuned Bandpass Filters," the *microwave journal,* July 1964, pp. 48-52.
3. Wilds, R. B., G. J. Wheeler and E. A. Cota, "Compact Tunable Filters," the *microwave journal,* May 1964, pp. 58-59.
4. Wolf, E. H., "Rectangular-Filter Approach to Remote Tuning," *Electronic Design,* March 2, 1964, pp. 34-36.
5. Bostick, G., "A Set of Practical Design Data for Quarterwave Coaxial Cavities," the *microwave journal,* April 1960, pp. 78-79.
6. *Very High Frequency Techniques,* Harvard University, Radio Research Laboratory Staff, McGraw-Hill, New York, N. Y., 1947, Chap. 28.
7. *The Microwave Engineers' Handbook,* Horizon House, Dedham, Mass., 1966.

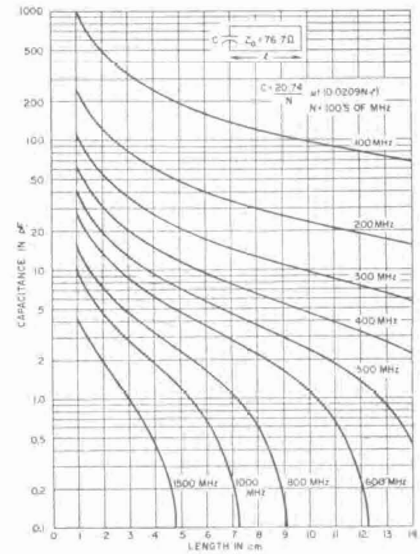

Figure 2 — Capacitance vs. line length for given frequency.

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