

RADIO ENGINEERS' HANDBOOK

BY

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The cut-off frequency depends upon the rate of taper, and is lower the more gradual the taper, in accordance with the relation

$$\frac{L_2}{L_1} = \frac{C_1}{C_2} = \epsilon \left(4\pi \frac{l}{\lambda_c} \right) \quad (78)$$

where L_1 and C_1 are the inductance and the capacity per unit length at the closely spaced end, L_2 and C_2 are the corresponding values at the wide end, l is the length of the line, and λ_c the distance corresponding to a wave length at the cut-off frequency (in the same units of length as l), calculated on the basis of the constants at the narrow end.

The ratio of impedance transformation is approximately

$$\text{Ratio of impedance transformation} = \sqrt{\frac{Z_{02}}{Z_{01}}} = \epsilon^{2\pi \frac{l}{\lambda_c}} \quad (79)$$

where Z_{02} is the characteristic impedance on the basis of the spacing at the wide end of the line, Z_{01} is the characteristic impedance based on the spacing at the other end of the line, and l and λ_c have the same meaning as above. The ratio of impedance transformation accordingly depends upon the difference in spacing at the ends of the line, *i.e.*, upon the total taper, and can be easily made as great as two to one. The impedance match obtained at the ends of the exponential line may be improved by adding terminal reactances of complexity determined by the extent the reflection coefficient at the terminals must be minimized over a frequency range.¹

NETWORK THEORY, FILTERS, AND EQUALIZERS

18. Network Definitions.—A network is made up of resistances, inductances, capacities, and mutual inductances connected together in some manner. The resistances, inductances, mutual inductances, and capacities involved are termed *network constants* or *parameters*. When these parameters are constant, independent of the current going through them, the network is said to be *linear*.

A typical network is illustrated in Fig. 60. The junctions a, b, c , etc., at which the current can divide are termed *branch points*, and the sections of the network between branch points are termed *branches*. A series of branches that form a complete loop is termed a *mesh*. Examples of meshes are shown by the arrows in Fig. 60, where five separate meshes are designated.

A *passive network* is a network containing no source of energy, in which no energy is dissipated other than that accounted for by the resistance elements of the network. An *active network* is a network containing one or more sources of energy, or some sink of energy.

The term *two-terminal* is applied to networks operated under the conditions shown in Fig. 61a. Here the only applied voltage is that shown acting between terminals 1-2 obtained by opening some branch of the network. The term *four-terminal* is applied to a network operating under the conditions illustrated in Fig. 61b. Here a voltage E is applied in series with one branch of the network by opening up this branch to form terminals 1-2, while another branch of the network is opened up to form terminals 3-4, between which an output or load impedance is inserted. A four-terminal network is equivalent to a transmission system, and is sometimes referred to as a *transducer*.

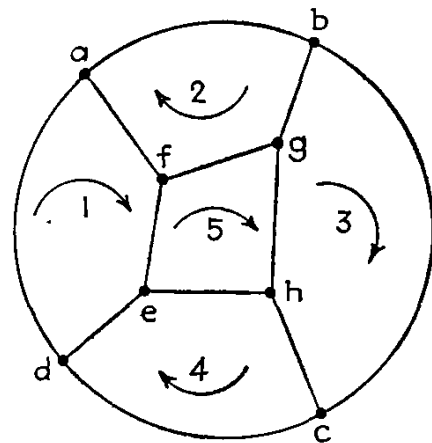


FIG. 60.—Network illustrating meshes, branches, and branch points.

¹ An excellent discussion of this subject is given by Wheeler, *loc. cit.*