Abstracts

The Synthesis of Symmetrical Waveguide Circulators

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A method for synthesizing symmetrical waveguide circulators by adjusting the eigenvalues of the scattering matrix is described. This procedure is particularly useful for the design of very compact circulators in the form of waveguide junctions containing ferrite obstacles. Permissible structural symmetries for a circulator are listed, and a standard form for the scattering matrix of a symmetrical circulator is defined. The synthesis procedure is then described in detail, stating the conditions to be imposed on the scattering matrix eigenvalues, and an expression is obtained for the changes in the eigenvalues due to the placing of anisotropic material within the junction. By applying the theory to Allen's 4-port turnstile circulator, it is shown that the use of a matched turnstile junction and a reflectionless Faraday rotator is not essential. The theory is also applied to the design of novel 3- and 4-port circulators, and two 6-port circulators, one of which may be used as a 5-position waveguide switch, are described. Some experimental results are presented for a compact 3-port circulator in the form of an H-plane Y junction, in 1 inch by ½ inch waveguide, containing a ferrite post obstacle. This circulator, which operates with a bias field of approximately 25 oersted, has a useful bandwidth of 3 per cent. Greater bandwidths would be expected in a Stripline or a fin-line version of this device.

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