Analysis of Six-Port Measurement Systems

A comparative scattering parameter analysis of various microwave six-port circuit configurations has been performed in relation to applications in single and dual six-port automated microwave measurement systems. The aim of this analysis was a confirmation of the predictions of the existing general six-port theories and a search for possible simplifications of these theories to be achieved through selective restrictions of their generality. Two circuit configurations have been, so far, analyzed. The first is the proposed preferred configuration having three q-points close to the 120° optimum locations and a fourth q-point at a great distance from the origin. The second is a "pseudo-symmetric" circuit configuration having four q-points nominally at the cardinal points of the gamma-plane unit circle. Microwave measurement systems based on the six-port principle fully reconstruct complex wave-vector ratios from sets of redundant magnitude-only readings. This leads to determining points in a complex plane as intersections of three or more circles. A simple conformal mapping may be used to visualize the resolution of this method and its sensitivity to errors in the magnitude readings. This mapping transforms families of constant-magnitude-ratio circles in straight parallel lines. The coordinates in the transformed plane are the measured magnitude ratio in dB and the angle between the tangents to the intersecting circles at the intersection points.

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