Multistrip Coupler Modeling: Normal Modes Decomposition

Abstract

Basic properties and different models of SAW multistrip couplers (MSC) are discussed, based on the assumption of two propagating rectangular orthogonal modes with symmetric and antisymmetric amplitude distribution (two-modes decomposition). It is shown that the symmetric and antisymmetric modes are essentially the waves propagating in the open- and short-circuit gratings with two different SAW velocities. Therefore, the known techniques for modeling reflective and non-reflective gratings can be applied to the normal mode MSC analysis. Using the acoustical boundary conditions the MSC scattering parameters can be expressed in terms of the modal scattering parameters.

The solutions for normal modes are obtained using the following techniques:

1) in the quasi-static approximation (neglecting SAW reflections near the MSC synchronous frequency)
2) reflective array model (RAM) based on the closed-form cascading of the elemental reflective cells
3) coupling-of-modes (COM) analysis
4) field approach based on the closed-form equations for the fundamental and first backward space harmonics.

Basic MSC properties both in the passband and stopband are discussed. The MSC simulation results are compared with the published experimental results.

Contents

Normal Mode Representation of a Multistrip Coupler

- Concept of a multistrip coupler (MSC)
- MSC modeling assumptions
- Boundary conditions
- Normal modes decomposition (two modes approximation)
- Physical meaning of the symmetric/antisymmetric modes

Properties of the normal modes in the periodic gratings

- Wavenumber and SAW velocity
- Reflection coefficient
- Dispersion relation

Multistrip coupler models

- Reflective Array Model (RAM)
- Coupling-of-Modes (COM) model
- Field approach (Ingebrigtsen’s model)
- Quasi-static approximation (Morgan’s model)

MSC simulated and experimental results

- MSC stopband and passband response
- Comparison with experimental data

Conclusions