# Abstracts

## Systematic Design of Stacked-Crystal Filters by Microwave Network Methods

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A class of novel frequency-selective devices, called stacked-crystal filters, is discussed in terms of a microwave network approach that leads to a systematic procedure for their analysis and design. These devices consist of two or more crystal plates that are stacked together, with thin electrodes being provided between some or all of the adjacent interfaces for the purpose of translating mechanical properties into electrical signals via piezoelectric coupling. In such a configuration, the electromechanical coupling that occurs at the plate surfaces produces selective interactions between the elastic modes in each crystal plate, as well as between these modes and all of the modes in the other plates included in a stack. A judicious combination of materials and dimensions can therefore provide a very wide range of desired filtering characteristics. For stacks with thin plates, only three thickness modes appear in each plate and they can be described in terms of three transmission lines; their coupling at the plate surfaces is then expressible in terms of ideal transformers that represent the mechanical junction between two adjacent plates. The interface electrodes appear as a set of terminals, to which are attached capacitators and another set of ideal transformers that represent the piezoelectric drive. In this manner, each plate can be rigorously described in terms of a well-defined network that serves as a building block. A stack consisting of any number of plates can therefore be regarded as the connection of an appropriate number of such building blocks, thus reducing a complicated mathematical problem to a systematic representation that can readily be handled by conventional techniques. A simple example of a two-layer quartz device operating on these principles is given. The simulated behavior obtained from the exact eqivalent network discloses that wide-band filters may be designed. Construction of such devices can be expected to yield robust, miniature filters of high performance possessing a large diversity of desired characteristics.

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