A Drop-On Band-Pass Filter for Millimeter-Wave Multichip Modules on LTCC

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***Abstract*—Low-temperature cofired ceramic (LTCC) is increasingly used to realize multichip modules (MCM's), even in the millimeter (mm)-wave frequency range. Fabrication tolerances of standard LTCC structures, however, still are limiting the performance of band-pass filters integrated directly on the LTCC substrate. This contribution therefore describes the design and the performance of a separate filter chip based on alumina which simply is placed on top and glued to the LTCC substrate using nonconductive epoxy. A special electromagnetic field coupling is used to provide both the interconnect of signal lines and filter ground. The design includes special measures to reduce the tolerance requirement for filter placement and glue thickness.**

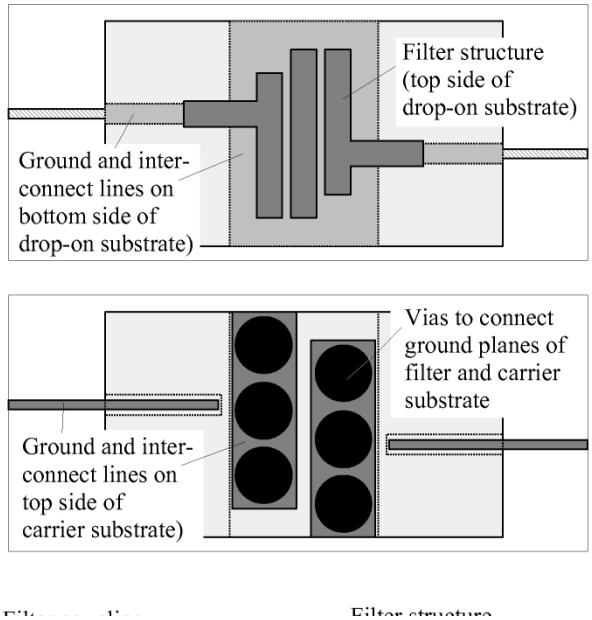
***Index Terms*— Electromagnetic coupling, microstrip filters, multilayer circuits, multichip modules.**

I. Introduction

COMPLEX microwave and millimeter (mm)-wave front-ends including a number of monolithic microwave integrated circuits (MMIC's) as well as interconnect lines and hybrid components today often are realized as multichip modules (MCM's) on low-temperature cofired ceramic (LTCC) [1]–[3]. In some applications, band-pass filters are required within these front-ends [4]. In the mm-wave range, a medium- to narrow-band filter may require tolerances in the range of a few microns, which is not realizable with the standard LTCC production process due to uncertainties with the shrinking of the material. Therefore, a filter was developed using a separate small alumina substrate. To enable an easy integration of the filter with the rest of the circuit, field-coupling was used, so that the filter simply can be glued on top of the LTCC substrate; no further steps are necessary. This technique therefore is compatible with standard LTCC processing procedures. The complete filter design and optimization was done using an in-house finite-difference time-domain (FDTD) code.

II. Design of the Band-Pass Filter

The three resonator filter is based on side-coupled resonators on top of an alumina substrate with capacitively coupled input and output lines. This capacitive coupling is realized using broadside coupled microstrip lines [5], where input and output lines are on the bottom side of the substrate. To this end, the ground plane in the coupling area has to be removed



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