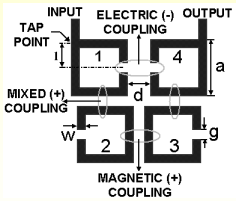
Microwave/ mm-wave Single, Dual, and Triple mode Filters

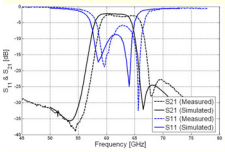
Ramanan Bairavasubramanian & Cesar Lugo

Advisor: Dr. John Papapolymerou

V-Band Prototype (Single Mode/ Single Layer)

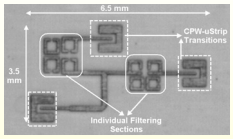


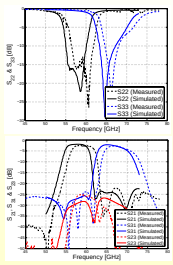
Half wavelength folded open loop resonators (microstrip)



Allows different coupling mechanisms (electric and magnetic)

V-Band Duplexer



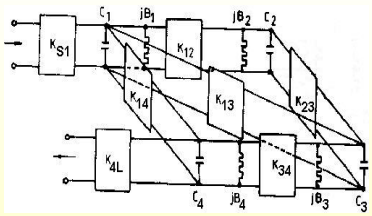


Liquid Crystal Polymer (ε_r = 3.15, tan δ = 0.0035, h = 152 um)

- ***Return Loss < -13 dB***
- ***Insertion Loss ~ -2.5 dB***
- ***Isolation < -25 dB***
- ***Band Rejection < -22 dB***

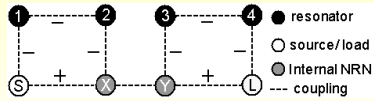
Introduction

- Pseudo-elliptic filters provide optimal compromise between in-band ripple and out-of-band rejection levels
- High rejection, modular and reconfigurable prototypes for advanced filtering applications are presented
- Designs include single and multimode filters operating at microwave and mm-wave frequencies



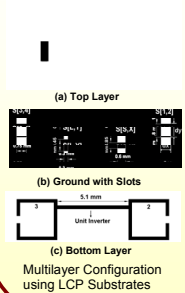
Cross Coupled Filters

Modular Filters (Single Mode/ Multilayer)

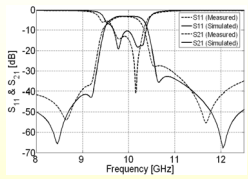


- Higher order filters realized using fundamental blocks of lower order
- Non-resonant nodes used as a cascading link
- Improved Modularity with less sensitivity to fabrication tolerances
- Multilayer implementation for compact and flexible design

X-Band Prototype

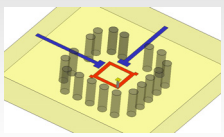


Multilayer Configuration using LCP Substrates



- ***4-Pole, 4-zero fully canonical response***
- ***Return Loss < -10 dB***
- ***Insertion Loss ~ -3 dB***

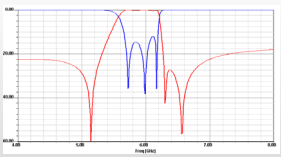
Fully Canonical Filter (Triple Mode*)



Multilayer Configuration using Rogers Duroid

- Triple Mode Resonator using a combination of dual mode loop and resonant cavity
- Perturbation in all three dimensions to realize a fully canonical resonator

C-Band Prototype



- ***3-Pole 3-zero Fully Canonical Response***
- ***f_0 = 5.2 GHz***
- ***FBW = 10%***

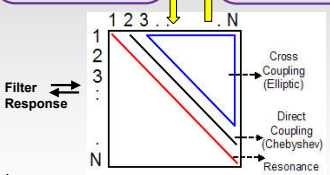
*** Patent Pending**

Specifications

- No. of Poles
- Fractional Bandwidth
- Return Loss Level
- Rejection Levels

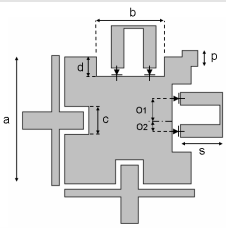
Implementation

- Appropriate Resonator Topology
- Extraction of Physical Dimensions
- Numerical Optimization



Coupling Matrix

Frequency Reconfigurable Filter (Dual Mode)

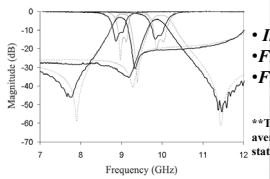


- Dual Mode Microstrip Patch Resonator
- Perturbation along axis of symmetry to split and couple the orthogonal resonant modes
- PIN diodes to achieve frequency reconfigurability

Conclusion

- Several filter prototypes, using single and multimode resonators, operating at a wide range of frequencies have been presented
- Cross coupling phenomena has been used to achieve high selectivity
- Design topologies with reconfigurable and modular characteristics can be used for advanced filtering applications

X-Band Prototype



- ***Insertion Loss ~ -3.5 dB***
- ***FBW ~ 3.8%***
- ***Frequency Variation ~ 10%***

****The loss and bandwidth quoted are average values over the two frequency states**

Rogers Duroid (ε_r = 10.2, tan δ = 0.0025, h = 625 um)

GEDC Industry Advisory Board, October 2006.