

FDTD BASED BROADBAND MEMS SWITCH DESIGN

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The design of a RF MEMS single pole double throw (SPDT) switch is investigated. It consists of two novel "toggle" Push-Pull switches and two conventional shunt air bridge switches in a coplanar environment. The toggle switch yields 0.25 dB insertion loss & 20 dB isolation up to 27 GHz in simulation and measurement, the complete SPDT structure is optimised for 50 dB isolation. The design is based on graded mesh FDTD simulations with special focus of buffer layer dielectric sheet modelling and broadband compensation of parasitic capacitances. One of the major design issues regarding optimisation of complex MEMS switching structures is the compensation of the mostly capacitive parasitic effects. For broadband applications, this compensation is at best done with simulation-optimised inductive transmission lines introduced in the close vicinity of the components. Due to coupling effects, the optimisation is to be based on full wave analysis of the complete switching structure. So many simulation runs are necessary for a complete design, making FDTD (Finite Difference Time Domain) integration of Maxwell's equations the first choice because of its superior computation speed. Thin dielectric buffer sheets (e.g. SiN, $t = 100$ nm) play an important role in MEMS switch structures. Those normally force FDTD's time step down, making simulation time longer. Thus buffer layer simulation is investigated in this contribution with regard to FDTD's stability criterion as well as equivalent thick sheet models are discussed. The MEMS switch is located on a $250 \mu\text{m}$ or $500 \mu\text{m}$ Si Substrate in a $50 \mu\text{m}$ coplanar environment. The actuation voltage ranges from 30 to 35 Volts, making the design suitable for power applications of up to 2 Watts (measured value). The SPDT is designed for switching times in the microsecond range.