The Spiral RF MEMS Switch in COMSOL Multiphysics

K. M. V. Swamy[1], B. G. Sheeparamatti[1], G. R. Prakash[1]

[1]Basaveshwara Engineering Collage, Bagalkot, Karnataka, India

Abstract

This work presents the study of spiral RF MEMS switch which has low actuation voltage due to spiral structure. This work is inspired by the superior performance of electrostatic RF MEMS switches over the conventional state-of-the-art solid-state devices and the potential applications in communication field. The customary high actuation voltage limits the reliability and applications especially in wireless communication, and hence focus on the realization of electrostatic low actuation voltage switches is rapidly increasing. The optimization of actuation voltage is achieved by analyzing the flexure design, beam topology, actuation electrodes and gap height using COMSOL Multiphysics models which are validated by simulations. It is observed that with more and more number of spiral ring structure actuation voltages can be reduced. The serpentine structure is suitable for low actuation switch is modeled and simulated in COMSOL Multiphysics. This developed switch has lowest pull-in voltage compared to other two geometries as shown in Figure 1, 2,3 and 4.

Reference

1. Stephen D. Sentruria, “Microsystem Design”, Kluwer Academic Publishers, 2001
2. http://en.wikipedia.org/wiki/RF_MEMS.
3. FEM Electromechanical Modeling of a MEMS Variable Capacitor for RF Applications
4. Kamal Jit Rangra. “Electrostatic Low Actuation Voltage RF MEMS Switches for Telecommunications”. International Doctorate School in Information and Communication Technologies DIT - University of Trento.

Figures used in the abstract

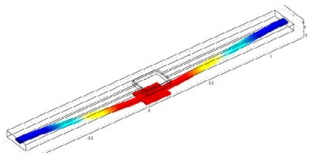

Figure 1: Figure 1 Plate suspended by two anchors showing displacement of 0.66μm for applied voltage of 25.2 V (Pull-in).

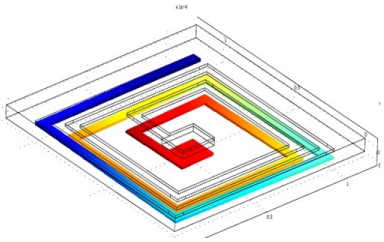

Figure 2: Figure 2 Three spiral electrostatically actuated switch showing displacement of 2nm for applied voltage of 5V.

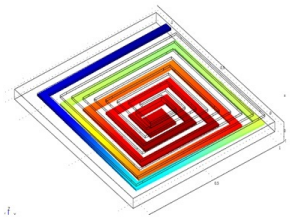

Figure 3: Figure 3 Solid model of Electrostatically actuated spiral RF MEMS switch showing displacement in COMSOL multiphysics.

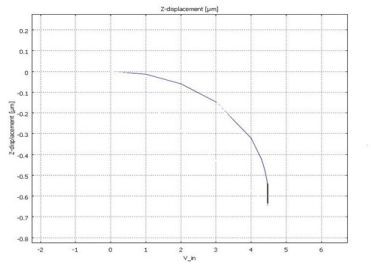

Figure 4: Figure 4 shows that hold on occur at 0.4 V and pull-in occurs at 4.475 V as shown in Figure 12, which indicates higher sensitivity.