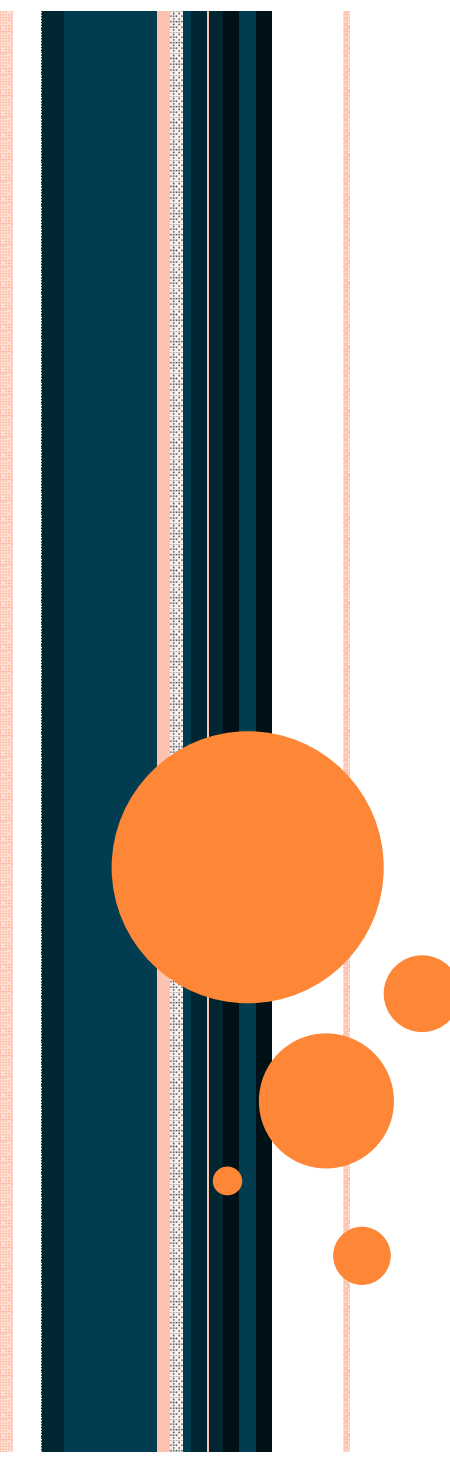




A PROPOSED II-STRUCTURE RF MEMS SWITCH FOR WIDE BANDWIDTH AND HIGH ISOLATION APPLICATIONS

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BRIEF

- A π -structure for RF MEMS switch based on numerical experimentation using 3D EM Simulator.
- It has very low insertion and return losses in the ON-state and very high isolation in the OFF-state, over a wide bandwidth.
- It exhibits a minimum isolation of 50 dB, in the frequency range from dc to 50 GHz, and of 30 dB in the frequency range from 50 to 60 GHz.
- The insertion loss ranges from 0.2 to 2 dB and a minimum of 25 dB return loss up to 50 GHz.
- The switch is actuated by a DC voltage of 30 to 50 volt.
- Both shunt capacitive and series resistive switch fabrication processes on the wafer are compatible.



- Micro-Electro-Mechanical (MEM) switches can be classified as cantilever beam switches or air-bridge (fixed-fixed) beam switches.
- Each of these can be electrically configured in series or parallel with an RF transmission line. They are designed to open the line or shunt it to ground upon actuation.
- The actuation mechanism can be electrostatic, magneto-static or thermal.
- The type of contact for each of these switches can be metal-to-metal contact or capacitive coupling.
- Miniaturized RF MEMS switches are electromagnetic components, which can offer size reduction, flexibility and reduction in the power consumption.
- The advantages of the MEMS switches are their extremely low series resistance, low drive power requirements, and negligible intermodulation distortion as compared to their solid-state counterparts.



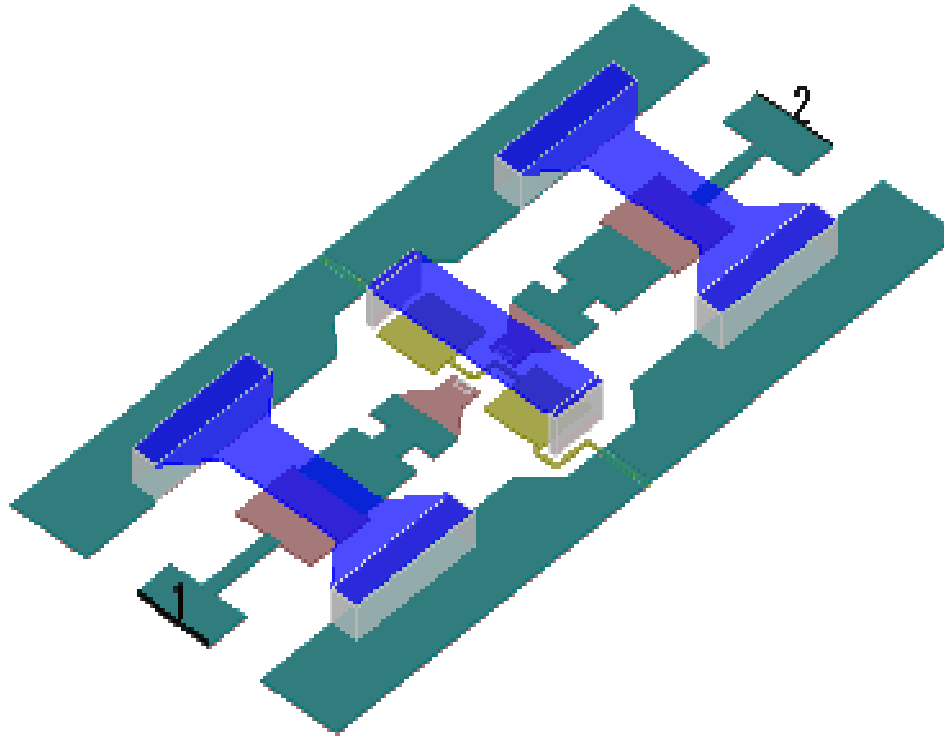
MEMS PARAMETERS

- The conventional RF metrics characterizing MEMS switches are:
 - 1) The insertion loss in the ON-state;
 - 2) The isolation (i.e. $1/|S_{21}|$) in the OFF-state; and
 - 3) The return loss (i.e. $1/|S_{11}|$) in both states.
- Achieving high isolation in the OFF-state and low insertion and return losses in the ON-state was a target .
- The demonstrated results are based on numerical experimentations using 3D EM simulator (Sonnet software).

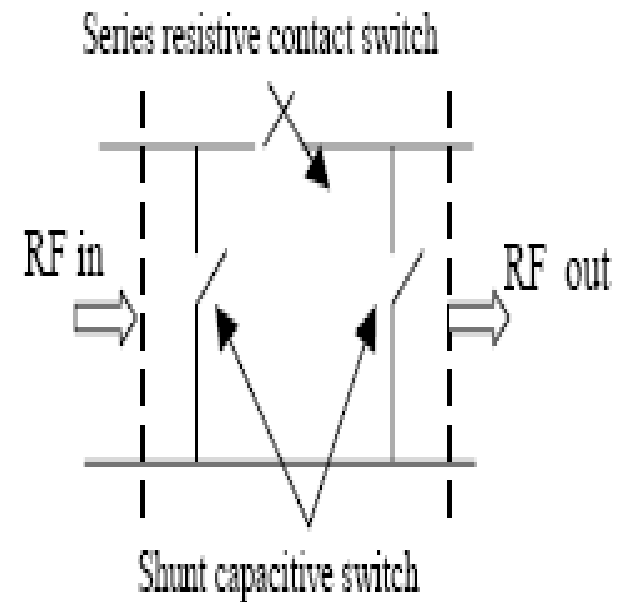


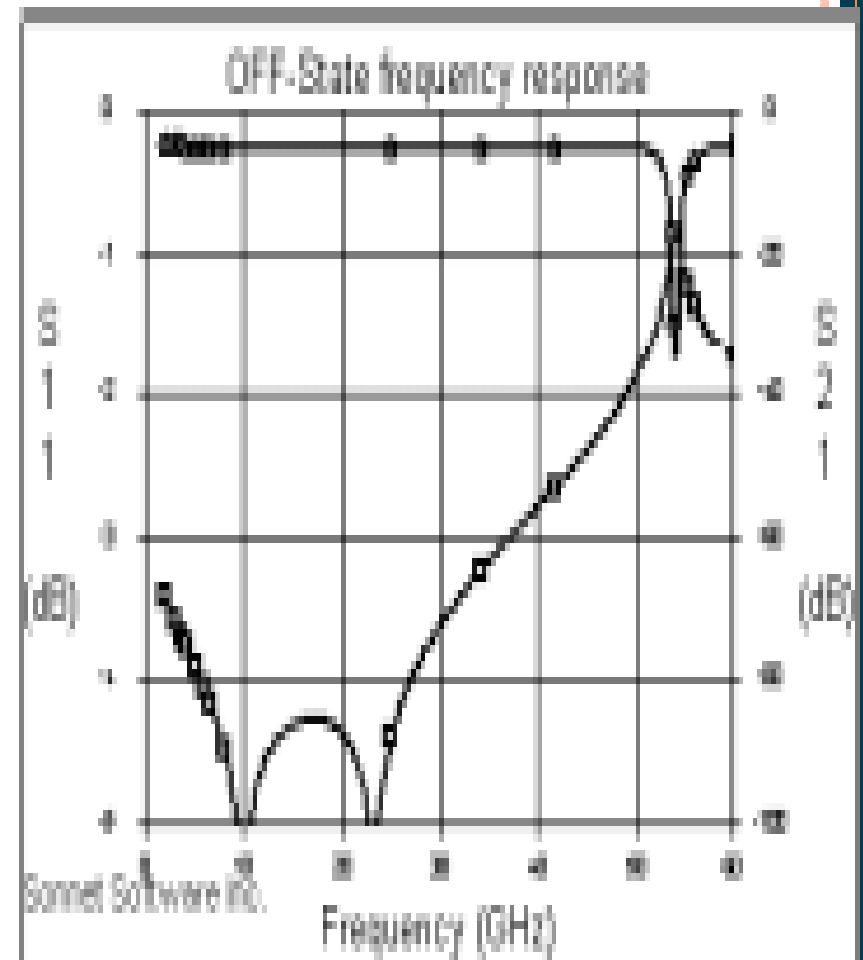
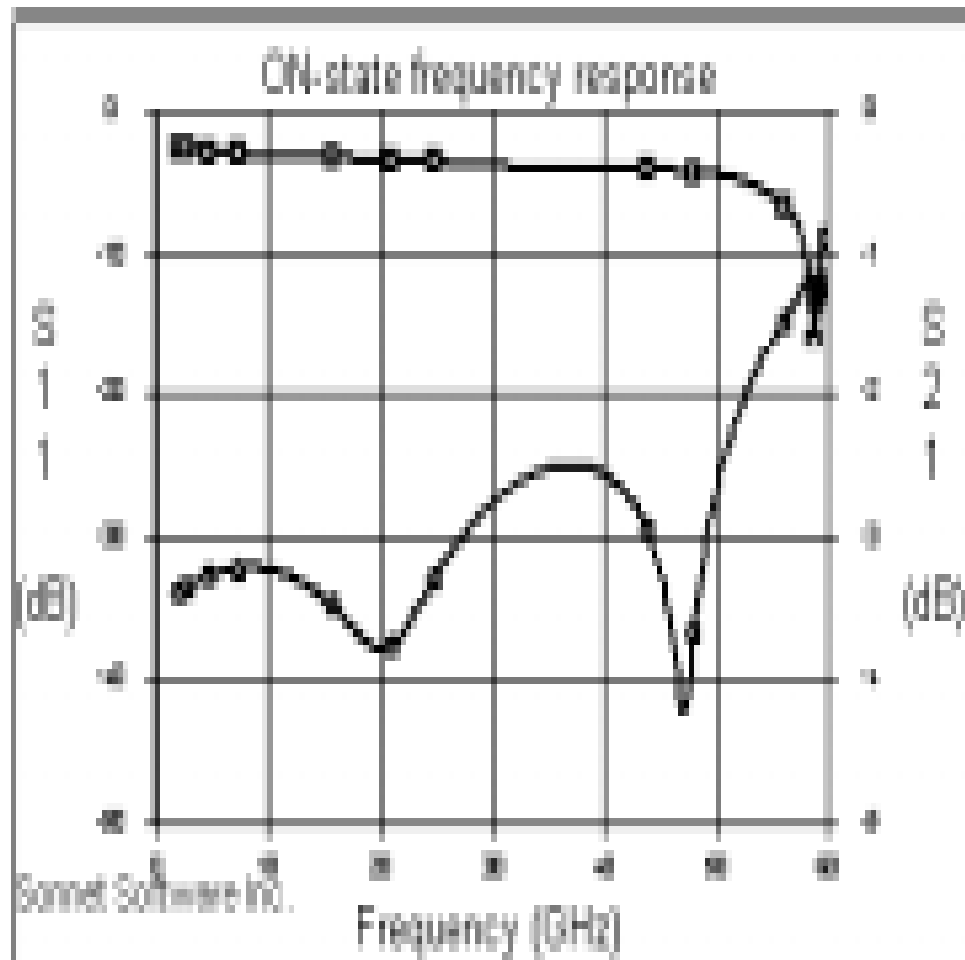
Π -STRUCTURE RF MEMS SWITCH

The proposed Π -structure RF MEMS switch



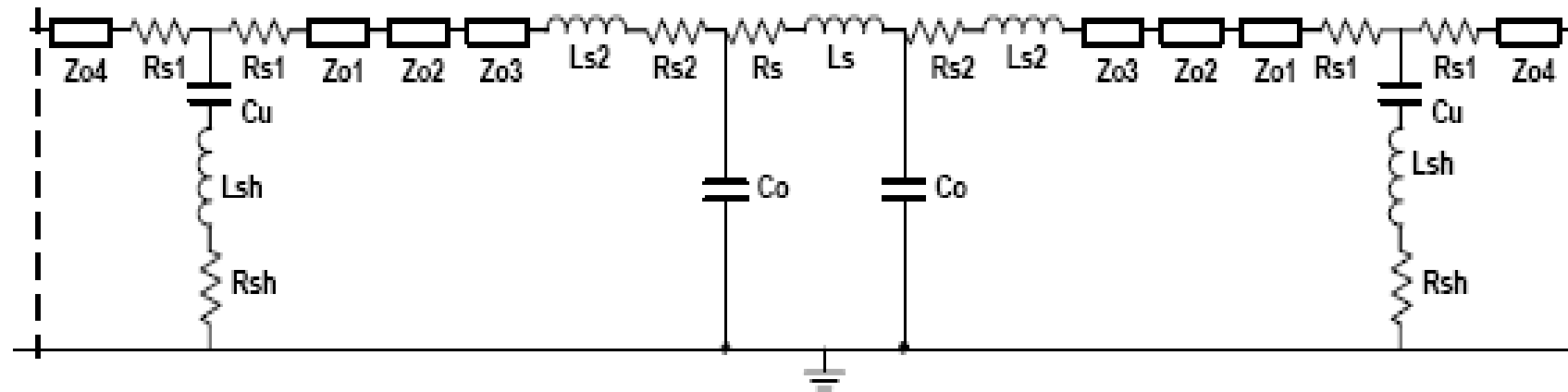
A Π -structure RF MEMS switch, which has been constructed as a shunt-capacitive/series resistive/shunt-capacitive configuration



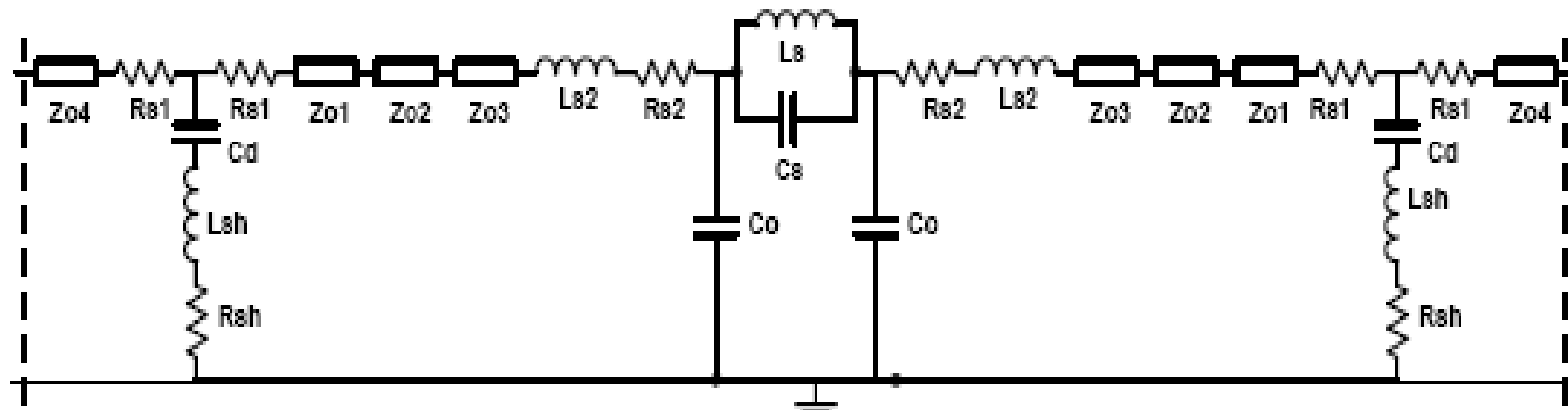


The frequency response for the π -type RF MEMS switch at the ON and the OFF-states



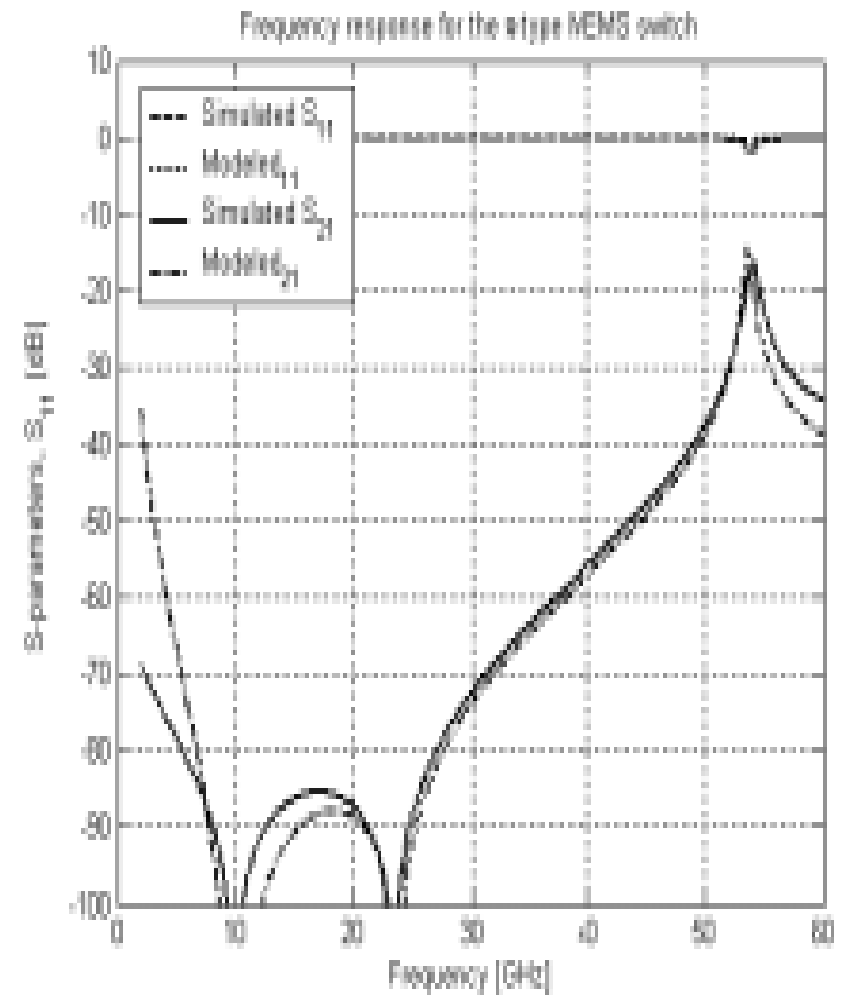
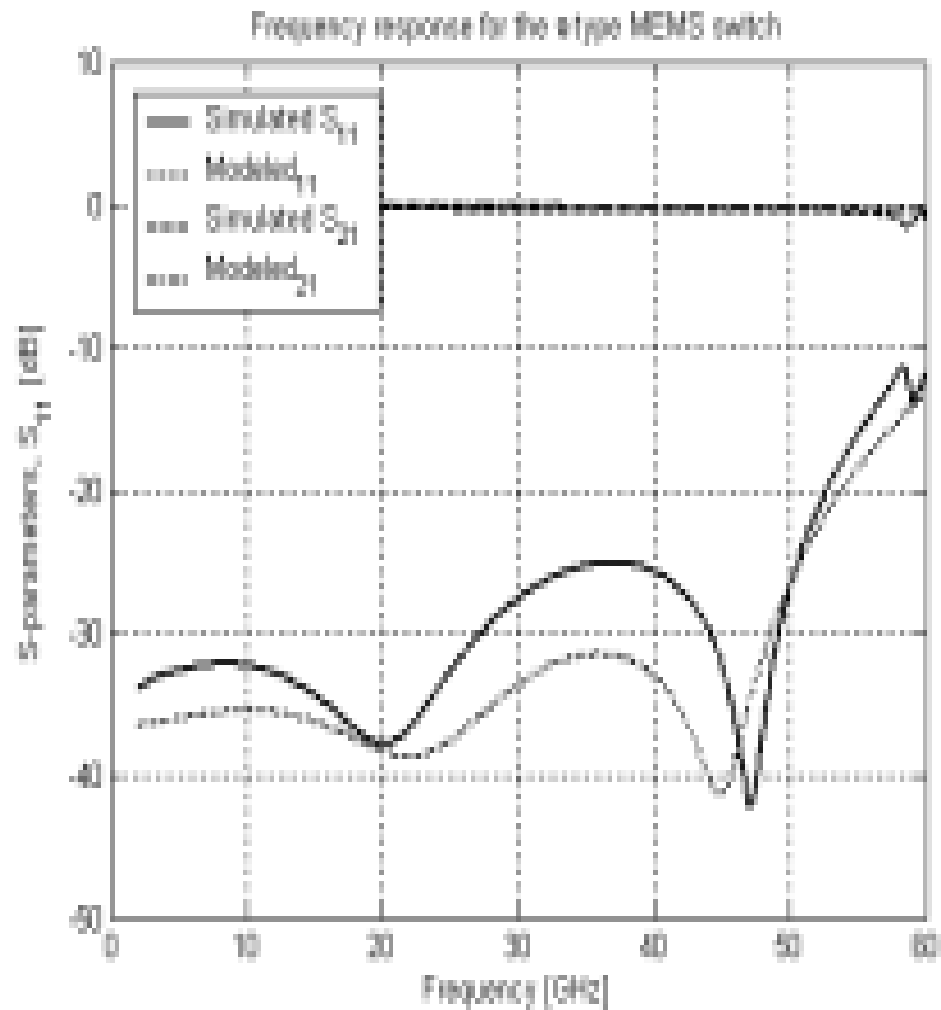


(a)



(b)

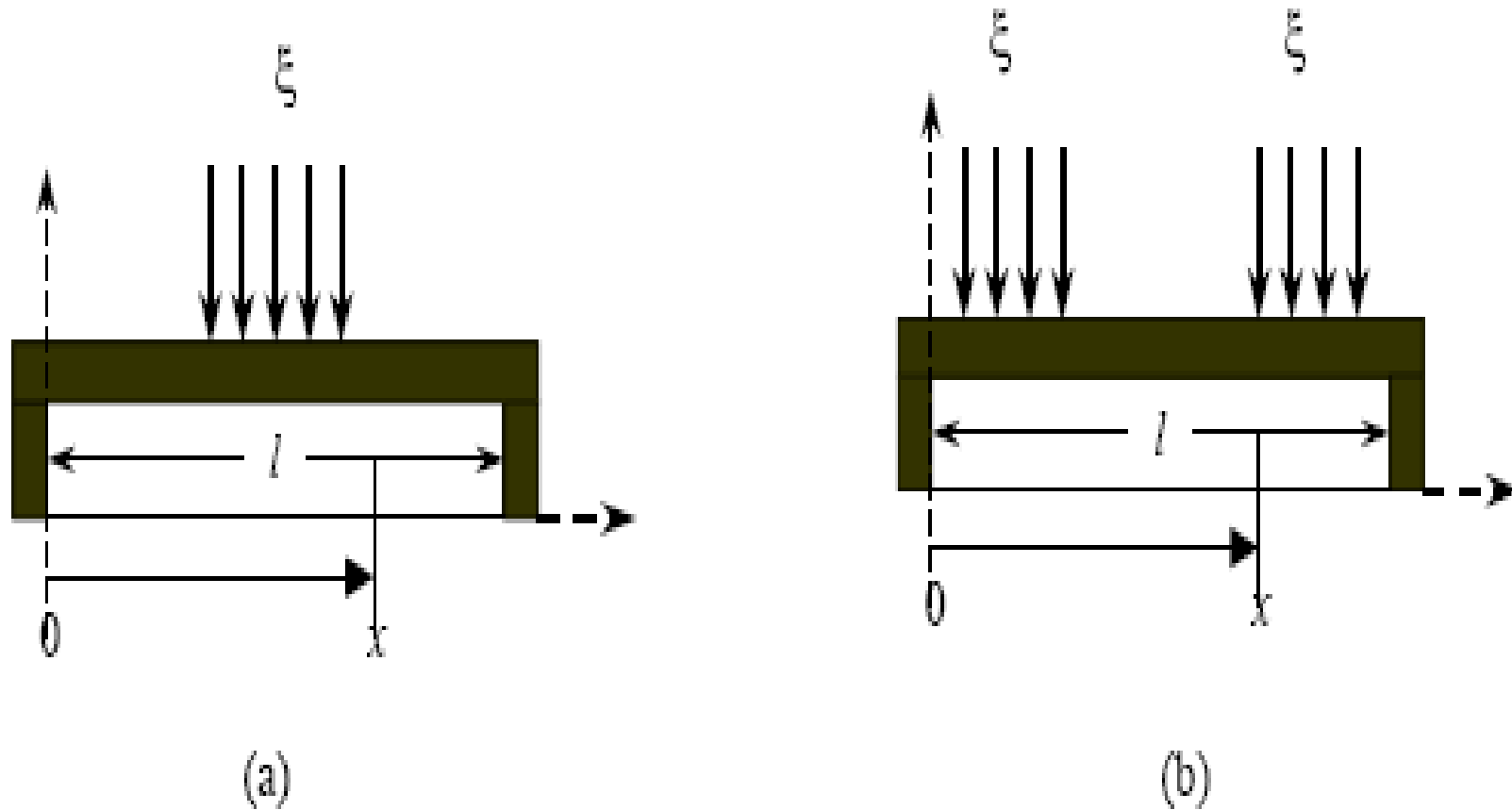
Electrical circuit model for the proposed π -switch at the a) ON-state and b) OFF-state



The simulated and the modeled S-parameters for the π -structure RF MEMS switch



MECHANICAL MODELING FOR THE PROPOSED Π -STRUCTURE RF MEMS SWITCH



The load distribution for (a) the shunt switch and (b) the series switch

CONCLUSION

- The proposed π -switch results in a minimum return loss of 25 dB in the range from dc to 50 GHz, and of 12 dB up to 60 GHz along with a minimum insertion loss of 0.4 dB up to 50 GHz in the ON-state.
- At the OFF-state the isolation is > 40 dB up to 50 GHz.
- The expected actuation voltage for this π -switch lies in the range of 30 to 50 volt.
- This switch is suitable for applications where a high isolation, low loss and good matching are required.

