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Title

Miniature MEMS Switches for RF Applications

Source

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Abstract

This paper presents a new way to design MEMS (microelectromechanical system) metal contact switches for RF applications using miniature MEMS cantilevers. A single 25 x 25 μm switch is first demonstrated with a Au-to-Ru contact, $C(u) = 5 \text{ fF}$ and $R(\text{on}) = 7 \text{ }\Omega$ at an actuation voltage of 55 V. The measured switching time is 2.2 μs and the release time is $< 1 \text{ }\mu\text{s}$. The switch is robust to stress effects (residual and stress gradients) which increases its yield on large wafers. To reduce the effective switch resistance, 10-20 miniature RF MEMS switches have been placed in parallel and result in equal current division between the switches, an up-state capacitance of 30-65 fF and a down-state resistance of 1.4-1.5 Ω . Furthermore, 10-20 element back-to-back switch arrays are developed and result in a marked improvement in the reliability of the overall switching device. A series-shunt design is also demonstrated with greatly improved isolation. The device has a figure-of-merit of $f(c) = 1/(2 \pi R(\text{on})C(u)) = 3.8 \text{ THz}$ ($R(\text{on})C(u) = 42 \text{ fs}$).