

RF MEMS: From Research to Products

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The talk will present the recent developments in RF MEMS, both in capacitive and metal-contact switches and switched-capacitors, and their path to introduction into real products. RF MEMS (radio frequency micro-electro-mechanical systems) offer far superior performance in terms of lower insertion loss and higher isolation, higher Q and capacitance ratio, higher frequency performance (up to mm-waves), higher power handling and much better linearity than solid-state switches and switched capacitors in the 1-100 GHz range. The wiSpry RF MEMS tunable capacitors with $C_r=6-8$ and $Q=80-100$ are now used as antenna tuning networks in Samsung cell phones (and other platforms to follow) and the Cavendish Kinetics RF MEMS tunable capacitors are being prepared for high volume insertion. Also, the Omron metal-contact switches with $R_s=1$ ohm and billion-cycle lifetimes and 0.1-10 W power handling have dominated the long life-time relay industry and being used in demanding automated test equipment. This was not achieved easily, but came after a sustained research and development effort spanning nearly 15 years (1996 to 2011). Along the way, several nagging problems were solved such as the design of stress insensitive actuators (due to manufacturing and temperature effects), contact material selection, dielectric charging mitigation, and related ultra-clean packaging techniques.

The talk will also present the latest designs in RF MEMS and how the UCSD-DARPA Center on RF MEMS is helping 12 industrial members and DoD in building the next generation RF MEMS switches and switched-capacitors, which are suitable for dense integration such as cell phones, or capable of handling up to 10-25 W of power at DC-20 GHz for base-station and defense systems. The talk will conclude with state-of-the-art examples of real system demonstrations using RF MEMS including tunable filters, tunable antennas, and other interesting circuits for 4G LTE systems.