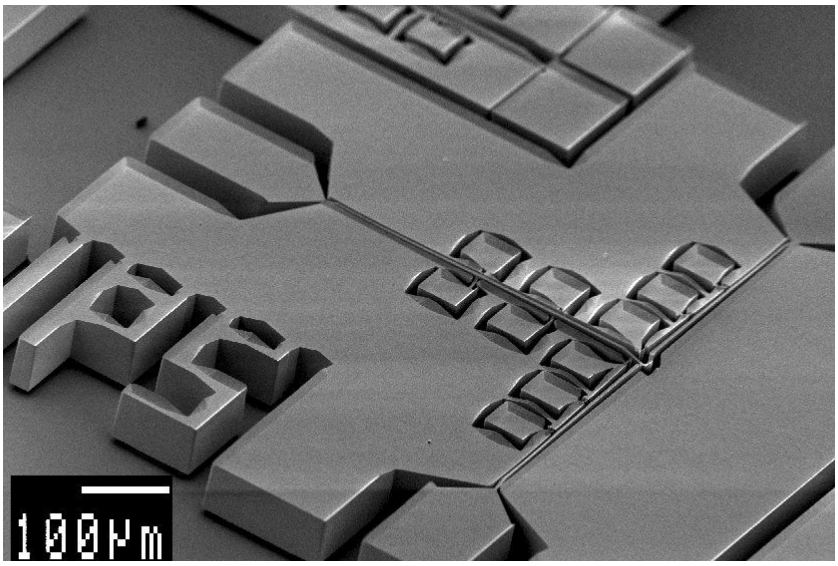
RF MEMS

Illustration

- ***RF*** actually means **Radio frequency**, i.e. at best **MHz**, but it is now understood to mean "high frequency" (sometimes abbreviated ***HF*** in German) in the sense of ***GHz*** frequencies.
  - In this frequency range you can forget most of what you learned about running **AC** current through wires. You actually wire, if you go up the frequency range, first becomes a coaxial cable (**MHz**), than a wave guide (**GHz =** $\mathbf{10^9}$ **Hz**), i.e. a hollow tube, and finally an optical wave guide, i.e. a glass fibre or simply "nothing" (= air) for optical frequencies at ≈ **300 THz = 300 ·** $\mathbf{10^{12}}$ **Hz**.
  - Capacitors and inductors as individual elements start to loose their meaning in the upper **GHz** range (ever seen a capacitor for light?) and signal generation, propagation and detection becomes a special science and engineering discipline with special components and products
- Presently, we have Microwaves in use everywhere **-** from your microwave oven (operating roughly around **10 GHz**) via all kinds of microwave sensors e.g. in your car, to serious ***RADAR***; actually an abbreviation for **RA**dio **D**etection **A**nd **R**anging.
  - We also have "optics" from the far **IR** to the **UV**. The only frequency range not used for some application is the lower **THz** region, but it is a major research area at present.
  - In any case, if you want to do something useful in "**RF**", you need some devices. Most trivial, you simply need switches to turn some transmission on and off (without simply unplugging the power supply) or to route it form here to there. Simply interrupting a piece of wire won't necessarily do the job because that may just produce is a capacitor with very little resistance at high frequencies.
- If we now look at the connection between **RF** technology and **MEMS**, we find, e.g., the following statements in the Net:
  - **RF** microelectromechanical structures (**MEMS**) are replacing conventional microwave devices in various wireless transceiver applications, offering the advantages of improved isolation, lower power dissipation, and reduced cost, size, and weight. Emerging **RF MEMS** devices include switches, high **Q** capacitors and inductors, couplers and power dividers, filters, resonant structures, etc.
  - Microelectromechanical Systems (**MEMS**) applications in **RF** and microwave electronics are on the verge of revolutionizing wireless communications. In particular, **RF MEMS** promises to endow wireless handsets, base stations and satellites with the key properties of low-power consumption and reconfigurability, which in turn will enable superior functionality and performance. In this course, a comprehensive exposition of the state-of-the-art in **MEMS** technology applied to **RF** devices, circuits and systems is given.
    The topics to be presented include: **RF MEMS** fabrication technology, **MEMS** Actuators, Passive devices (Transmission Lines, Capacitors, Inductors, Switches, Varactors, Resonators), Circuits (Filters, Oscillators, Phase Shifters, Couplers), Systems (Transceivers, etc.)
    The IEEE Boston Section Techsite
    http://www.ieeeboston.org/edu/2006spring/mems.htm
  - **MEMS** technology can be used to implement high quality switches, varactors (variable reactors), inductors, resonators, filters and phase shifters. Among the broad range of applications the **MEMS** technology gives a unique possibility to implement micromechanical resonatores and filters with high performance regarding selectivity and **Q**-factors. When combining these mechanical structures with microelectronics, central parts in wireless systems, RF systems (Radio Frequency systems) can be implemented.
    Examples can be various types of oscillators, **VCOs** (Voltage Controlled Oscillators), mixers and sharp filters. The **MEMS** structures can thereby replace traditional costly and large off-chip discrete components by making possible integrated solutions that can be batch processed. Vibrating **MEMS** resonators and filters that have been implemented so far are based on mechanical vibrations in lateral or vertical directions on Silicon wafers. Different types of beams, comb structures and disks can be used.
    From **RF MEMS** at the Department of Informatics, University of Oslo.
    http://heim.ifi.uio.no/~oddvar/rfmems.htm
- Subtracting the hyperbole still leaves us with some possible applications that we may use in the not too distant future.
  - The picture shows an actual example of a "**RF switch**" and the picture caption gives an idea of why **RF** technology is special.



Source and copyright: KTH - Royal Institute of Technology, Sveden

http://www.ee.kth.se/php/index.php?action=research&cmd=showproject&id=23

2006-2007: Micromachined **3D**-transmission line embedded, mechanically-multistable single-pole-single-throw (**SPST**) and single-pole-double-throw (**SPDT**) switches with very low intrusive **RF** design (low reflections, low insertion loss), since the complete switch mechanism is fully embedded in the signal line of a coplanar waveguide. The switches are mechanically multi-stable, feature active opening, and are fabricated in a single photolithography mask process