

# A Carbon Nanotube based NEMS oscillator

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An oscillator based on a suspended carbon nanotube NEMS resonator is presented as core element to Voltage Controlled Oscillator and Sensor applications. Besides its topology, printed circuit board and CMOS implementations of the NEMS oscillator loop are shown.

**Oscillator Topology** 



- Oscillation frequency f<sub>0</sub> imposed by CNT electromechanical resonator
- Mechanical information encoded in piezoresistive CNT current @  $2f_0$
- Low-noise front-end for best SNR and attenuation of feed-through
- Closed-loop : Phase- & frequencydetector adjusts VCO frequency to  $f_0$
- Open-loop : Characterization of CNT via DC input & output signals

Front-end (PCB)

G

Large interconnection capacitance challenges read-out of feeble signals at high frequencies

## **CMOS** implementations

Phase- & Frequency- Detector generates control voltage proportional to the phase and frequency discrepancy between VCO and CNT



1nH

1nH

#### **Current-mode front-end** implemented on PCB [1]

S<sub>v<sup>2</sup>,contact</sub> R<sub>contact</sub>





### **Applications**





References	[1] Wideband Low-Noise RF Front-End for CNT-NEMS Sensors, C. Kauth, M. Pastre, M. Kayal, MIXDES, Poland, 2012
	[2] Embedded MEMS actuators for CNT straining tests, Lee, Di, Muoth, Roman, Truax, Hierold, Nano-Tera APM, 2012
	[3] Atomic Oxygen Chemisorption on Carbon Nanotubes, Kroes, Pietrucci, Andreoni, Groening, Nano-Tera APM, 2012

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