

MEMS Oscillators For Clocks

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History and actual status

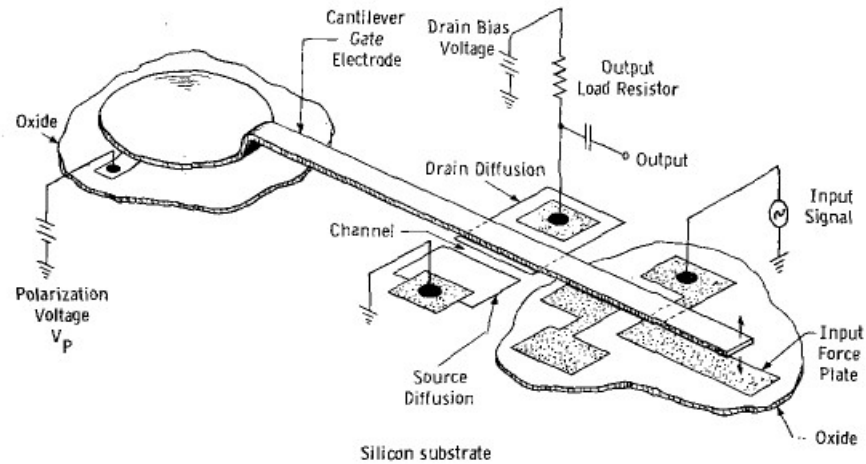
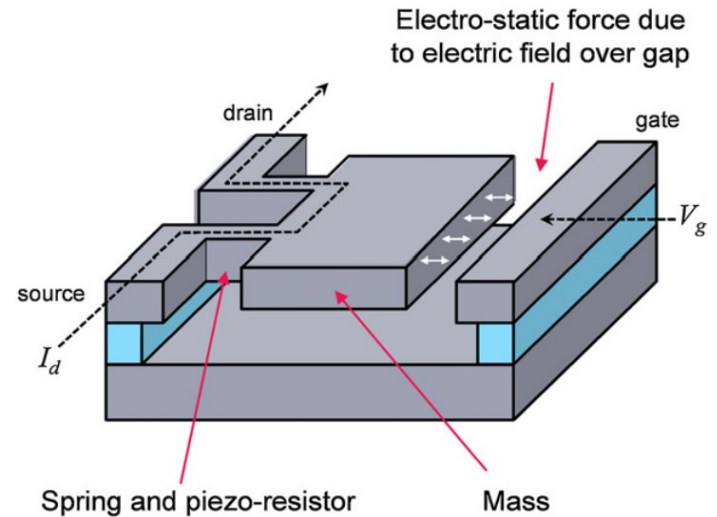


Fig. 1. Geometry and circuit connections of an RGT with a C-F resonant beam.

Nathanson, H.C.; Newell, W.E.; Wickstrom, R.A.; Davis, J.R. (1967). "The resonant gate transistor"

First Si MEMS oscillator - 1967



J T M van Beek and R Puers 2012 J. Micromech. Microeng.

Current Si MEMS oscillator

**CMOS IC
Temperature Stability**

MEMS operation principle

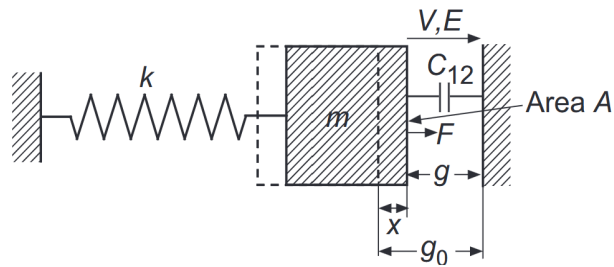


Figure 2.8 Spring-mass equivalent of a MEM resonator with electrostatic transduction.

Low-Power Crystal and MEMS Oscillators, Eric Vittoz, 2010, Springer

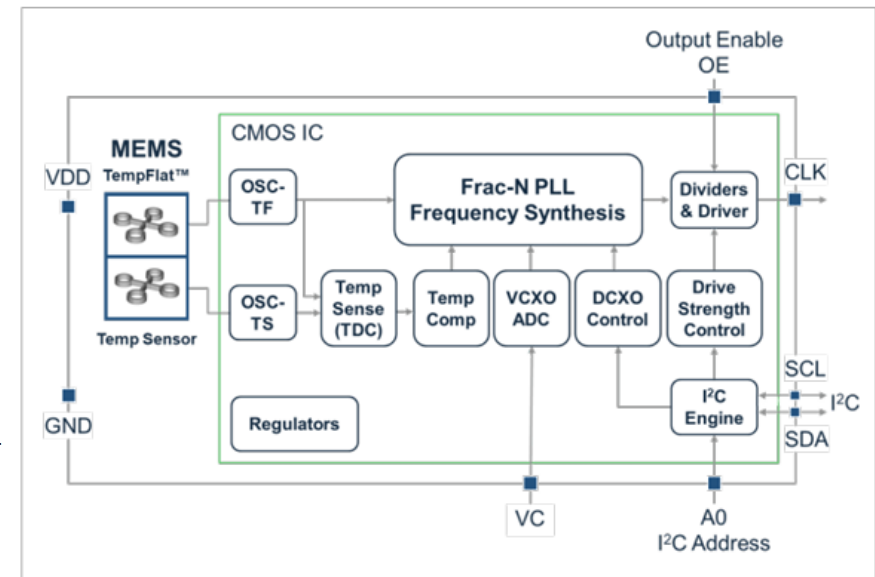
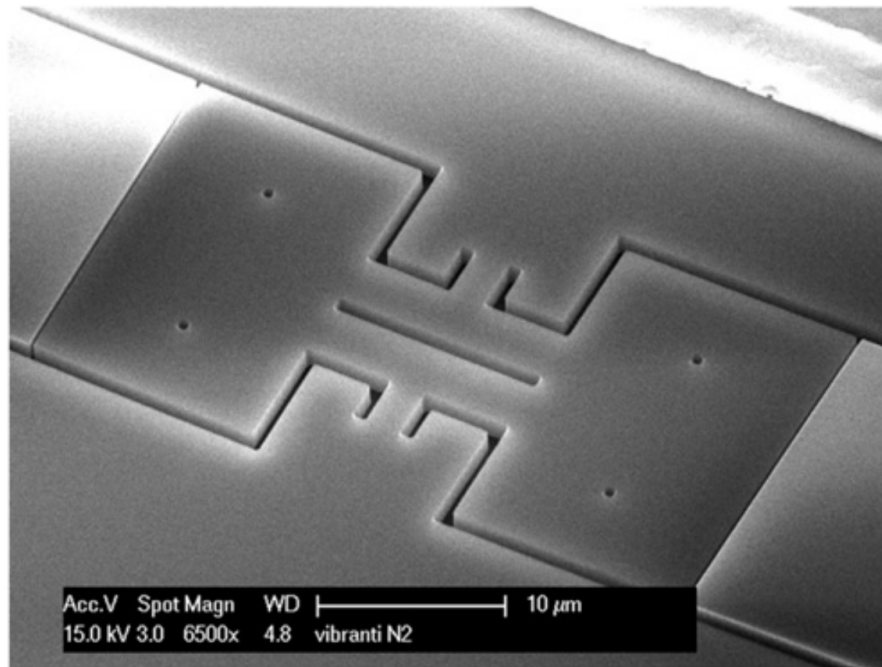
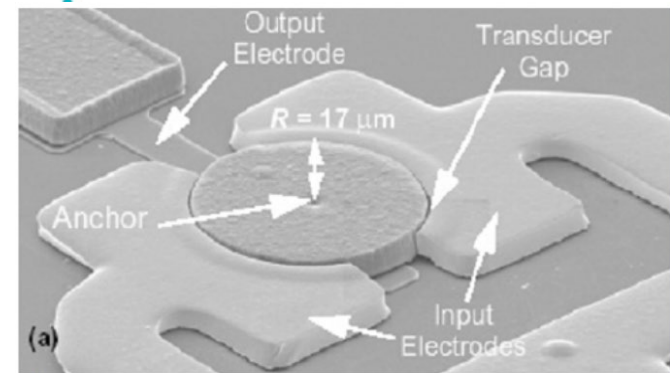
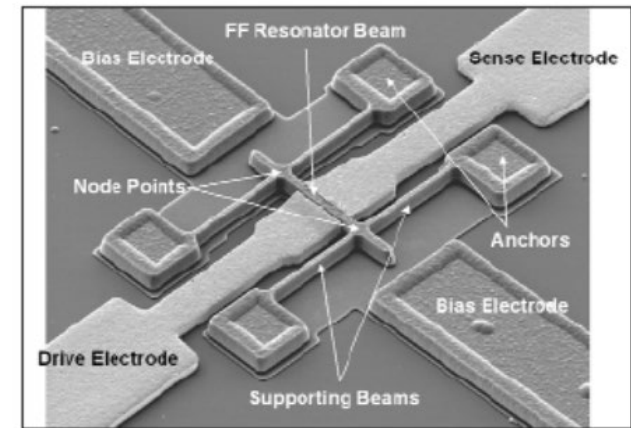


Figure 1. SiT5146 Block Diagram



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FET Resonator



Hsu, W. & Best, W. & De Los Santos, Hector. (2004). Design and fabrication procedure for high Q RF MEMS resonators. Microwave Journal.

Mechanical Resonator

Characteristics



<https://www.mouser.ch/ProductDetail/Microchip-Technology/DSC6003MA3B-032K768?qs=sGAEpiMZZMildj7qu1ydrQG1afnrXLdG%252BDV573txvZ%2FJdlg0To8eHg%3D%3D>

DSC6003MA3B-032K768

- 32.768 kHz
- Stability : 20 ppm (all temperatures)
- Aging : 5 ppm (1st year)
- 1.3 mA / 1 uA
- Output : CMOS
- °C range : -40°C/+125° C
- 2x1.6x0.84 mm³
- Cost : 1.18.- (per 100)



<https://www.sitime.com/products/32-khz-oscillators/sit1532>

SiT1533

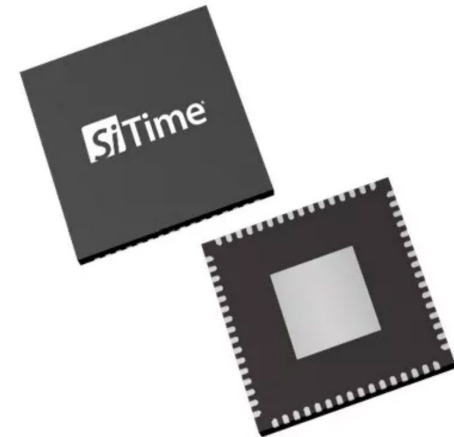
- 32.768KHz
- Stability : 100pm (varies with temperature)
- Aging : 1ppm (1st year)
- 1.6uA/0.2uA
- Output : LVCMOS
- °C range : -10°C/70°C
- 2x1.2x0.55 mm³
- Cost : 1.08.- (per 100)

How is the MEMS device packaged and interfaced ?

- Sealed package (vacuum)
- Resistant to shock (Thick)
- Usually 4 pin (VDD/GND/Enable/CLK)
- Some oscillators have a tunable oscillation frequency -> I2C interface

How is it integrated into products ?

- Stable Reference signal :
 - > Stable Clock signal
 - > Stable Time measurement

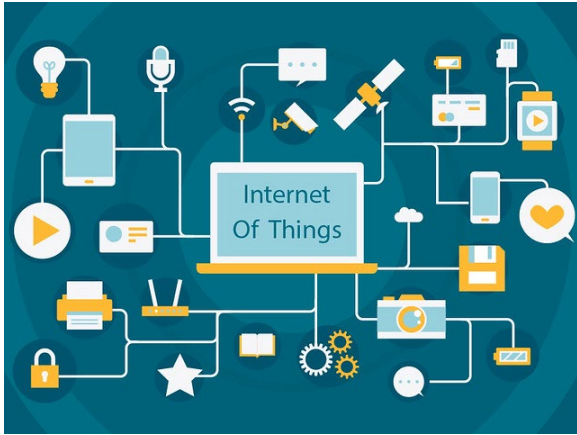


<https://www.sitime.com/products/mems-clock-generators/sit95141>

Products and current applications

Applications

- Low Power/Portable Applications: IoT, Embedded/Smart Devices
- Consumer: Home Healthcare, Fitness Devices, Home Automation
- Automotive: Rear View/Surround View Cameras, Infotainment System
- Industrial: Building/Factory Automation, Surveillance Camera
- Wireless Keypads
- Pulse-per-Second (pps) Timekeeping
- RTC Reference Clock
- Battery Management Timekeeping



live.staticflickr.com/4355/36802620122_fe3ca90fca_z.jpg



<https://www.dvidshub.net/image/935698/aerial-refueling-f-35-lightning-ii-joint-strike-fighters-eglin-afb-fla#.UZyEMrVU8QY>

References

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- <https://www.sitime.com/support/resource-library/datasheets/sit5146-datasheet>
- J T M van Beek and R Puers 2012 J. Micromech. Microeng. 22 013001
- <https://www.mouser.ch/ProductDetail/Microchip-Technology/DSC6003MA3B-032K768?qs=sGAEpiMZZMtldj7qu1ydrQG1afnrXLdG%252BDV573txvZ%2FJdlg0To8eHg%3D%3D>
- https://www.mouser.ch/datasheet/2/371/SiT1533_datasheet-1324419.pdf
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