

# Summary of analog filters

## Pure electronic / electric filters

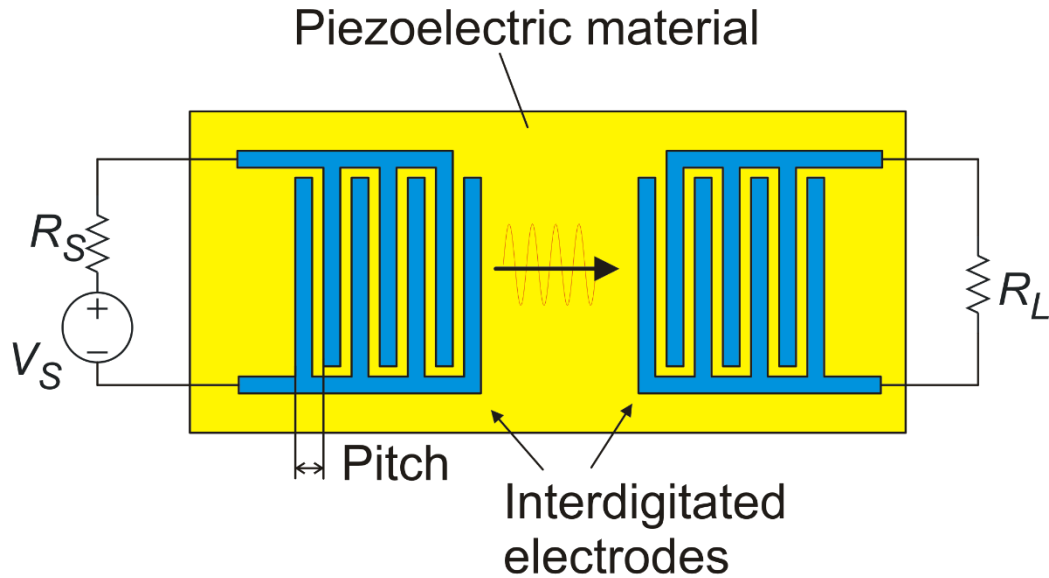
- **RCL passive filters**
- **Active RC filters**
- **Active Gm-C filters**
- Current mode filters\*
- **Switched-Capacitor filters**

## Electro-mechanical filters

- SAW (surface acoustic wave) filters\*
- BAW (Bulk acoustic wave ) filters\*
- MEMS resonators\*

\* Not covered in this course

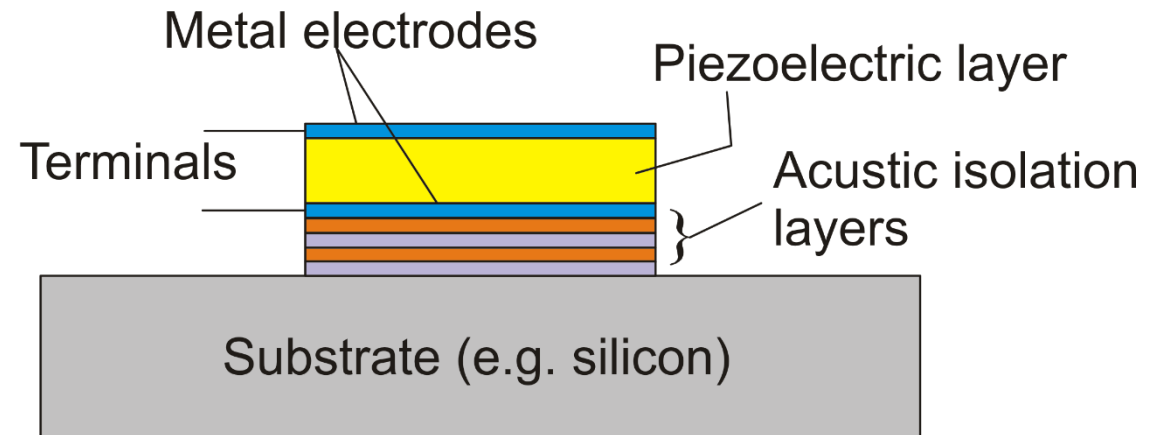
# SAW and BAW filters



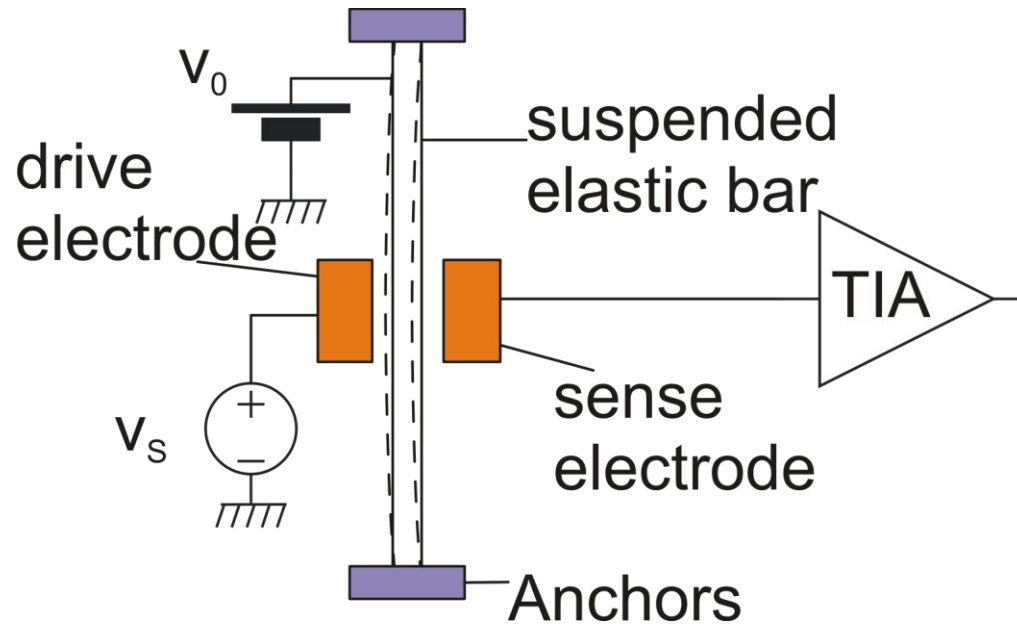
SAW basic device

$$f_{BP} = \frac{c}{pitch}$$

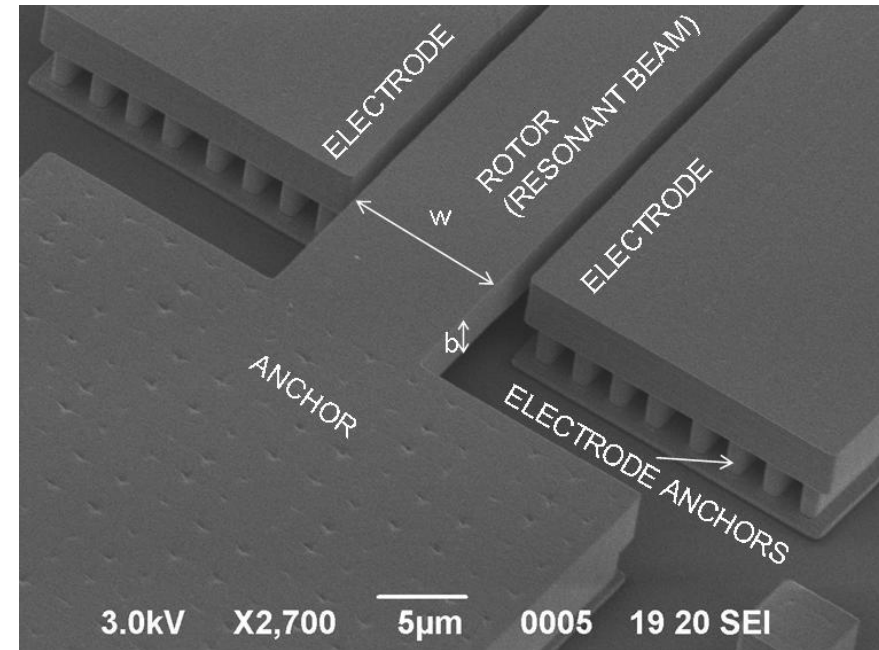
BAW device with Bragg reflector  
FBAR (Film Bulk Acoustic Resonator)



# MEMS resonators: examples



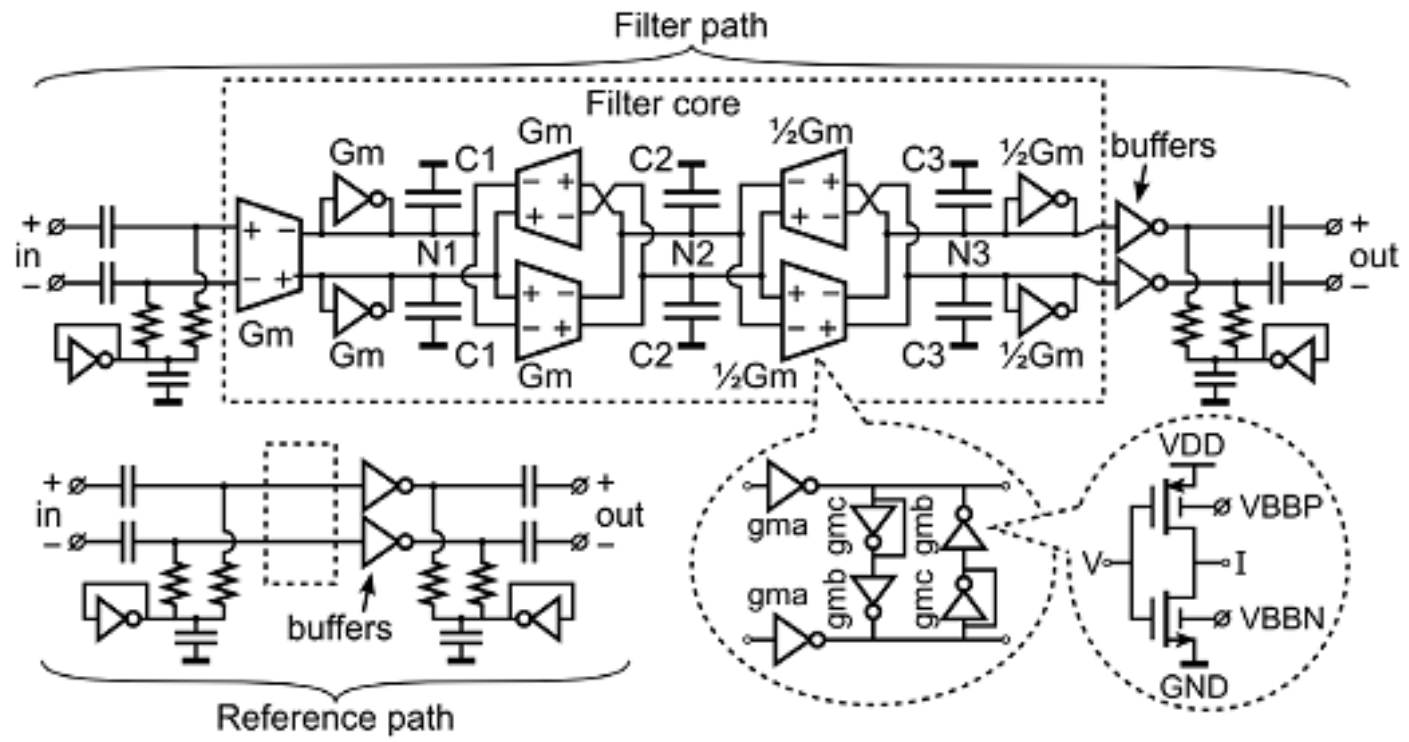
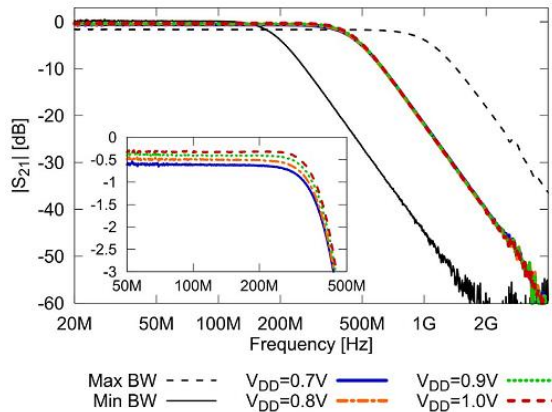
MEMS with capacitive actuation:  
principle of operation



A resonator designed at  
the DII – Unipi (F. Pieri)

# Examples of recently proposed integrated filters

The LP filter topology shown in Fig. 5.5.2 is derived from a 3rd-order, doubly terminated Butterworth LC ladder prototype using gyrator synthesis [1].



J. Lechevallier et. al, "A Forward-Body-Bias Tuned 450MHz GmC 3rd-Order Low-Pass Filter in 28nm UTBB FD-SOI with >1dBVp IIP3 over a 0.7-to-1V Supply" ISSCC 2015