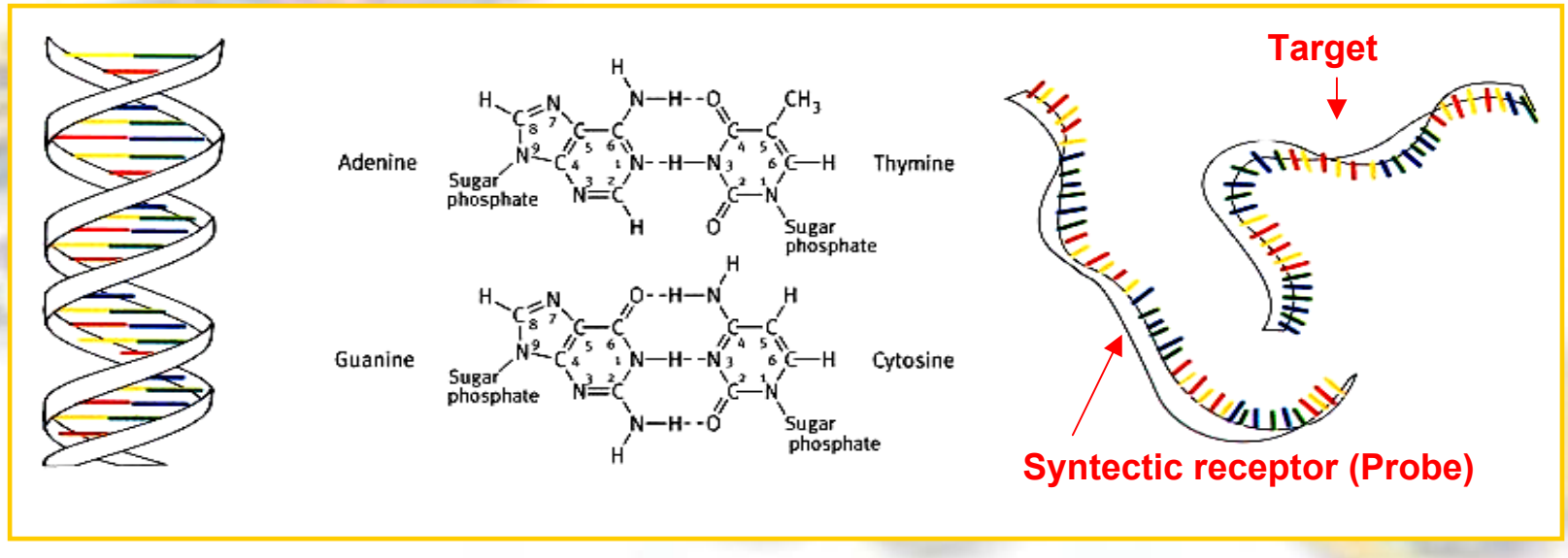
Hybridization reaction: base pairing



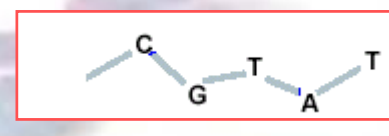
Hybridization Reaction depends on:

Sequence	**Solution**
Number of Complementary bases	Ionic Force
Percentage of G-C couples	Temperature

Point-of-care biosensors

- Implementation of biosensors based on the proximity of the biological sensing element and the electronic transducer
- Low-cost techniques
- Ease integration
- User friendliness and portability (outside clinical laboratories)

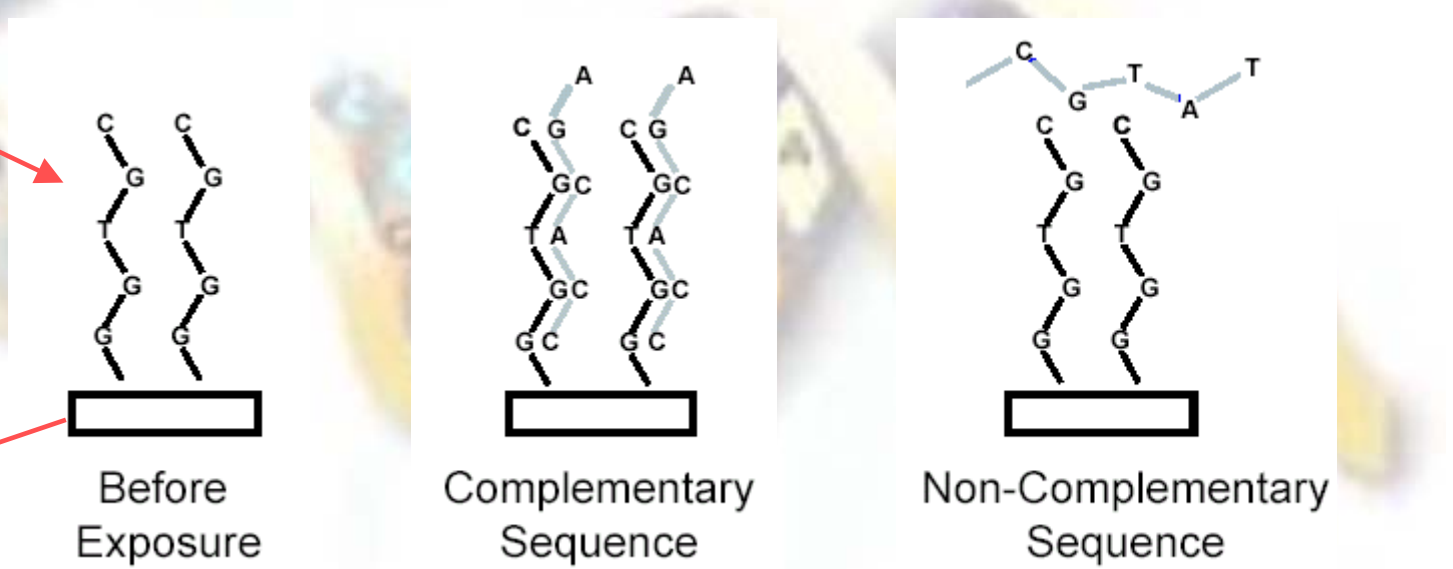
Localized recognition



Sample to test (TARGET)

Oligonucleotide of known sequence (PROBE)

Substrate

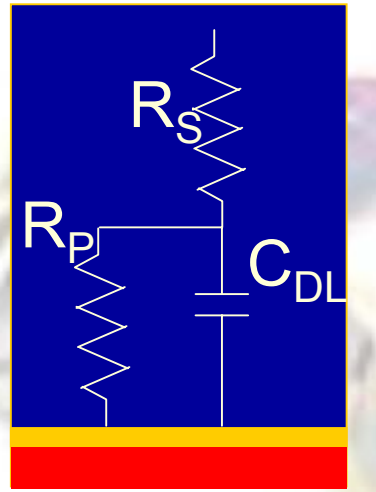


Syntetic Chemistry
Surface physical-chemistry
Analytical chemistry
Microfabrication tecnology

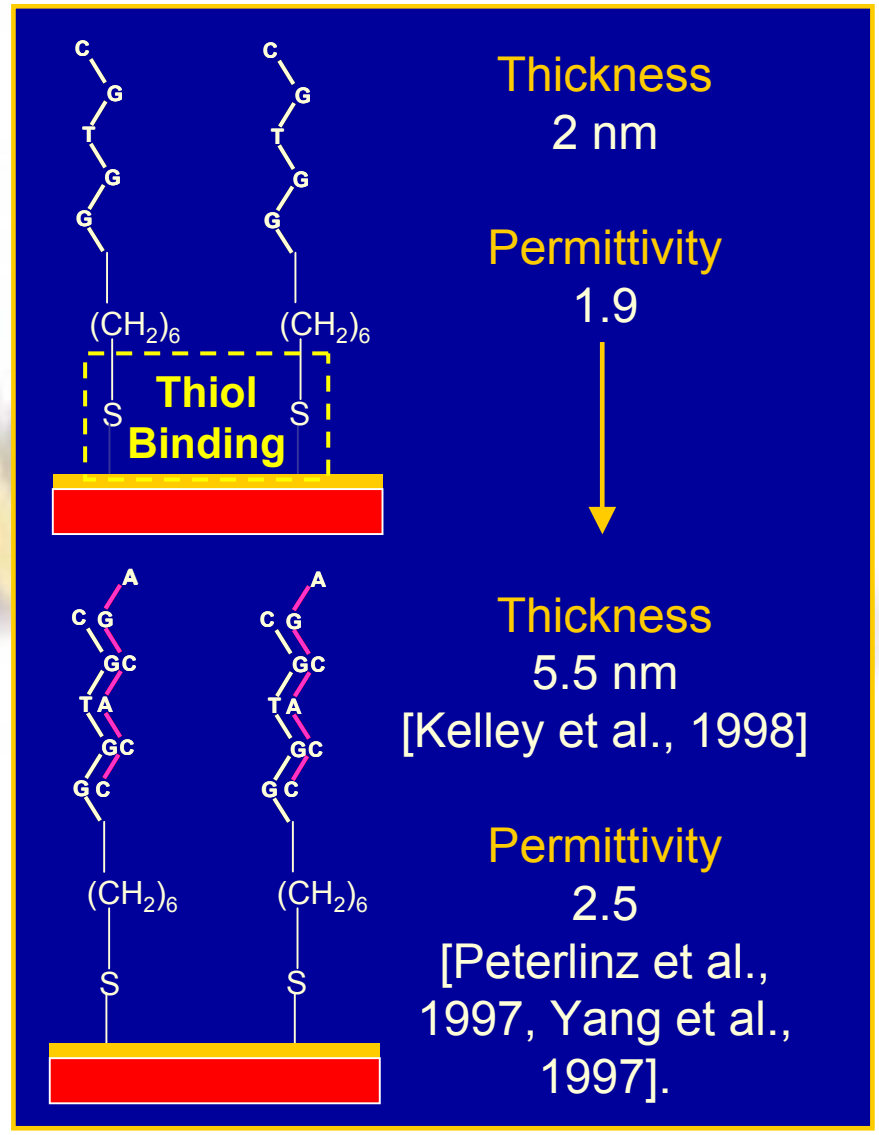
Know-how

Implementation of a sensing method or a transduction system

Electrical Impedance Detection Principle



Electrical gold/solution interface model



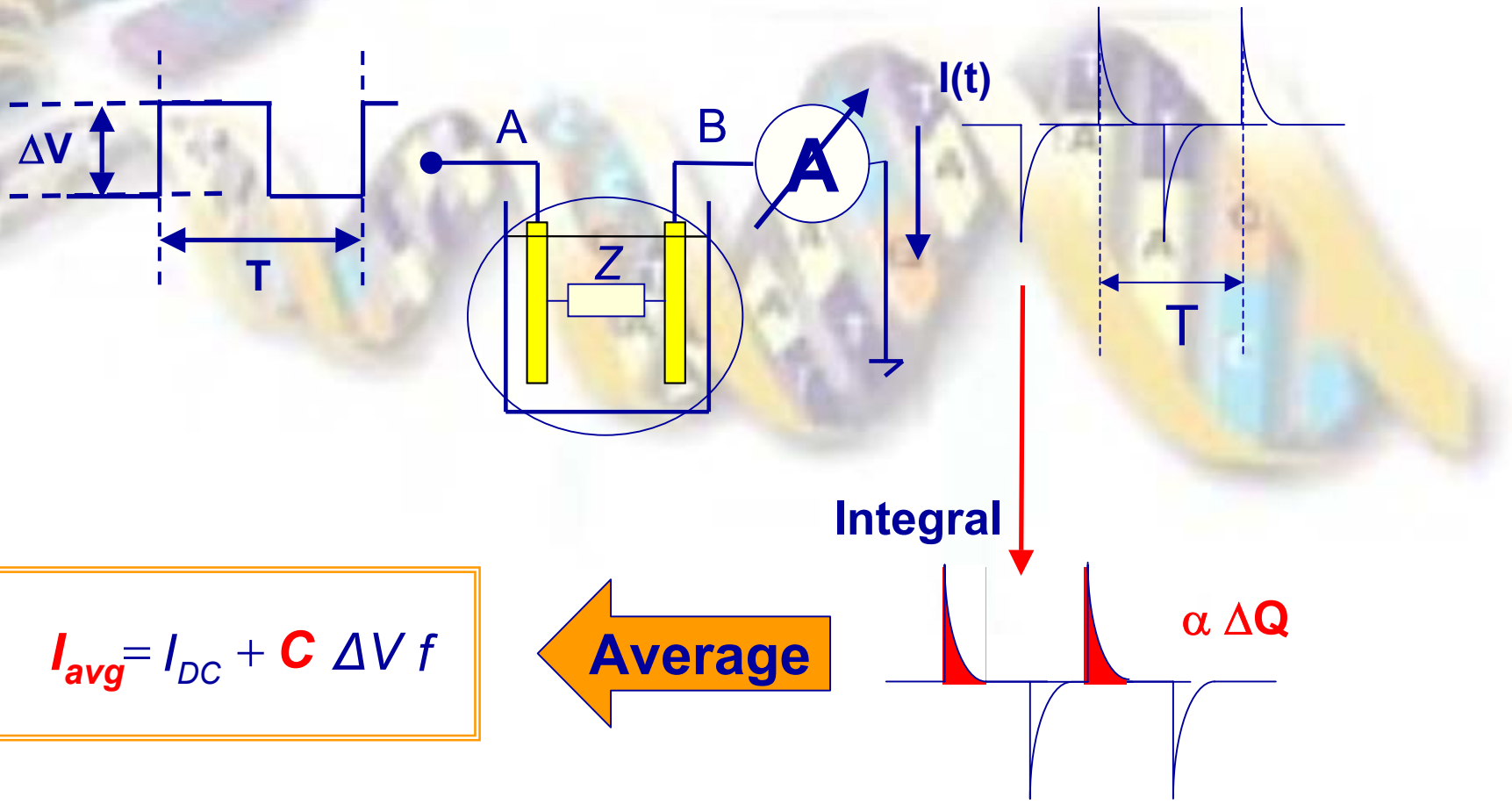
Static Regime

- **GenFet** (Souteyrand et al.,1997.Fritz et al.,2002. Ingdebrandt, 2003. Perkins et al., 2000)

Dynamic Regime

- **Chronoamperometry** (Berggren, 1998)
- **Impedance Spectroscopy** (Riepl, 1999. Janek,1997)
- **Charge-based measurements** (Guiducci, 2003)

Capacitance measurement by mean Charge Based Capacitance Measurement (CBCM)



$$I_{avg} = I_{DC} + C\,\Delta V\,f$$

Average

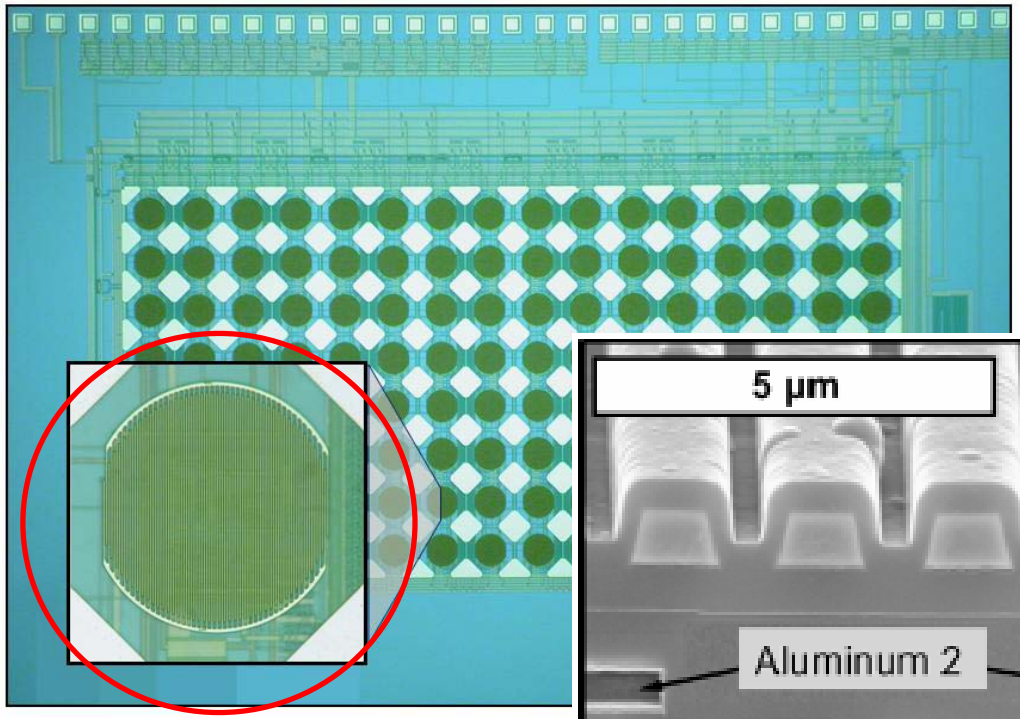
Infineon

Capacitance measurements on chip

- Flat Square Electrodes
- Different dimension (1 mm^2-0,0001 mm^2)
- Three slightly different implementations of CBCM technique

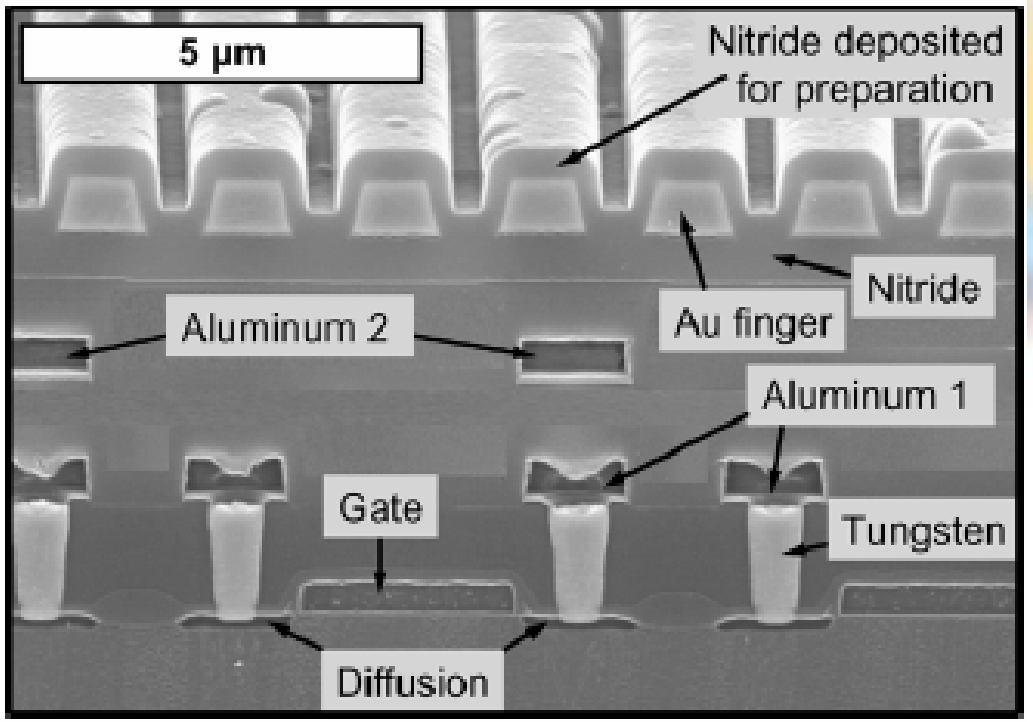
- Finger Electrodes
- Array: 128 pixels
- Conversion *C to f* and measurement of frequency on chip by mean 22 bit counter for every pixel

Microfabrication



ARRAY…

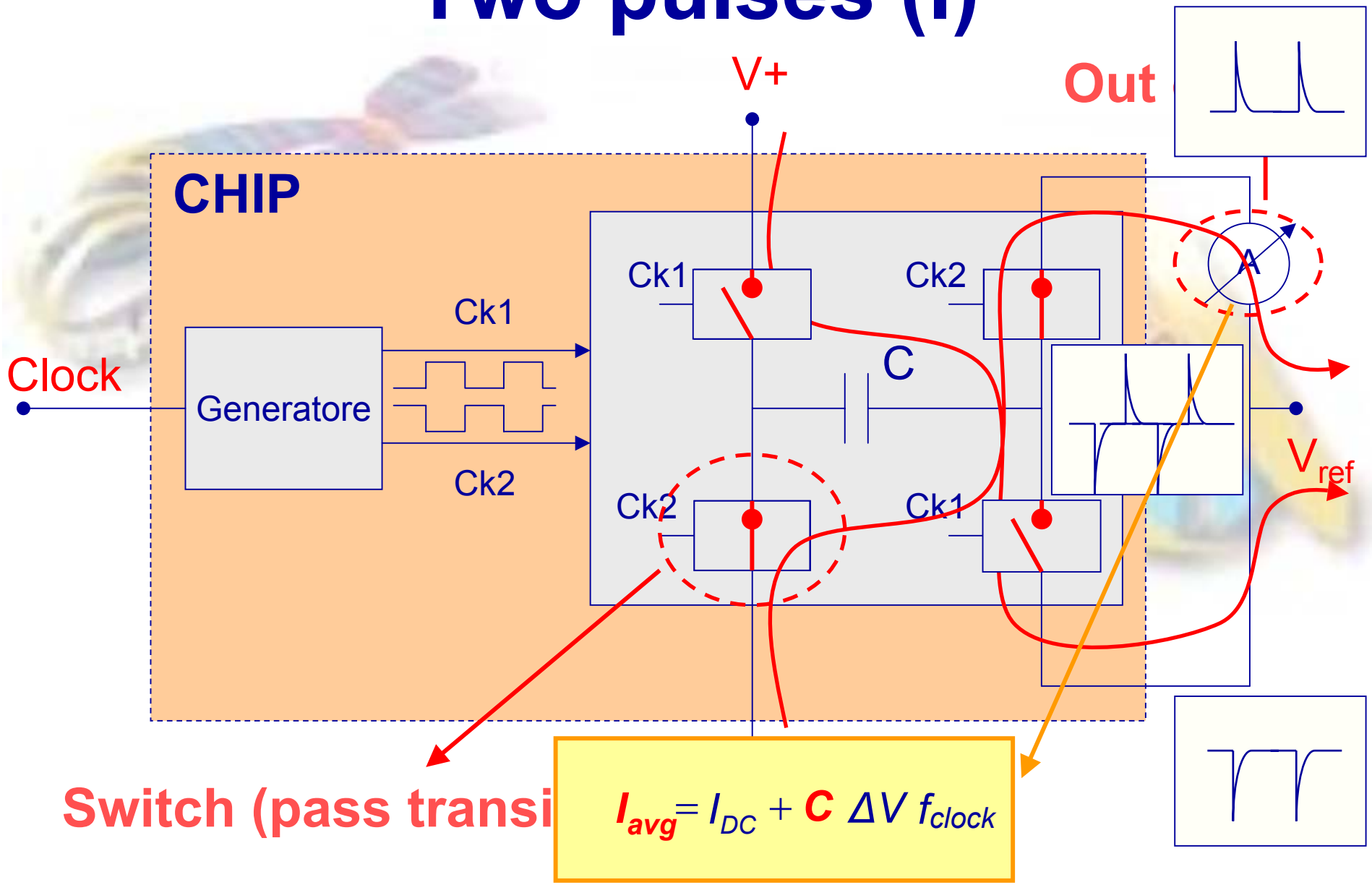
… but the process for gold flat electrodes is the same



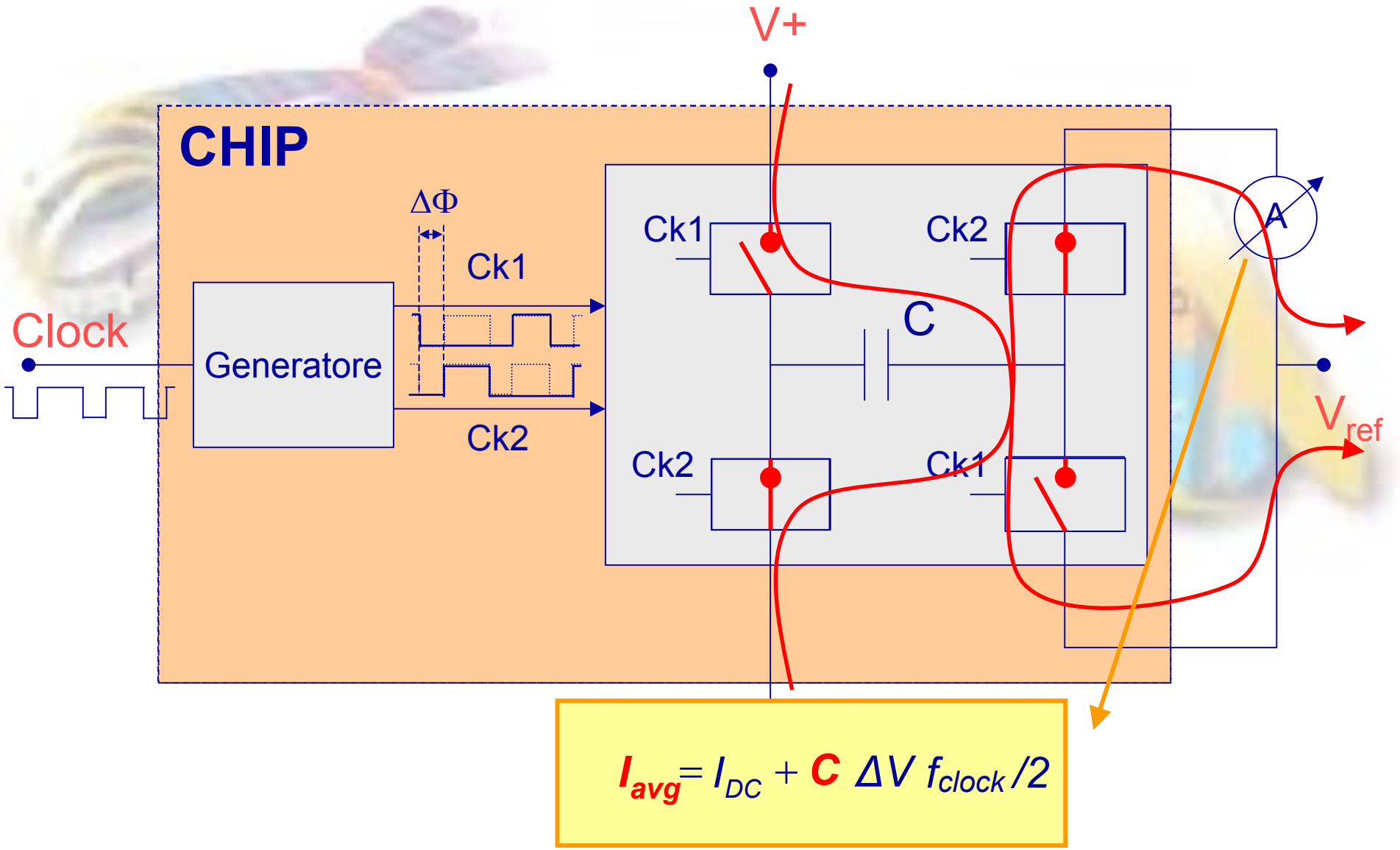
Flat electrodes: Measurements techniques

- Two pulses (I) (not ovelapping)
- Two pulses (II) (tuning overlapping)
- Three pulses

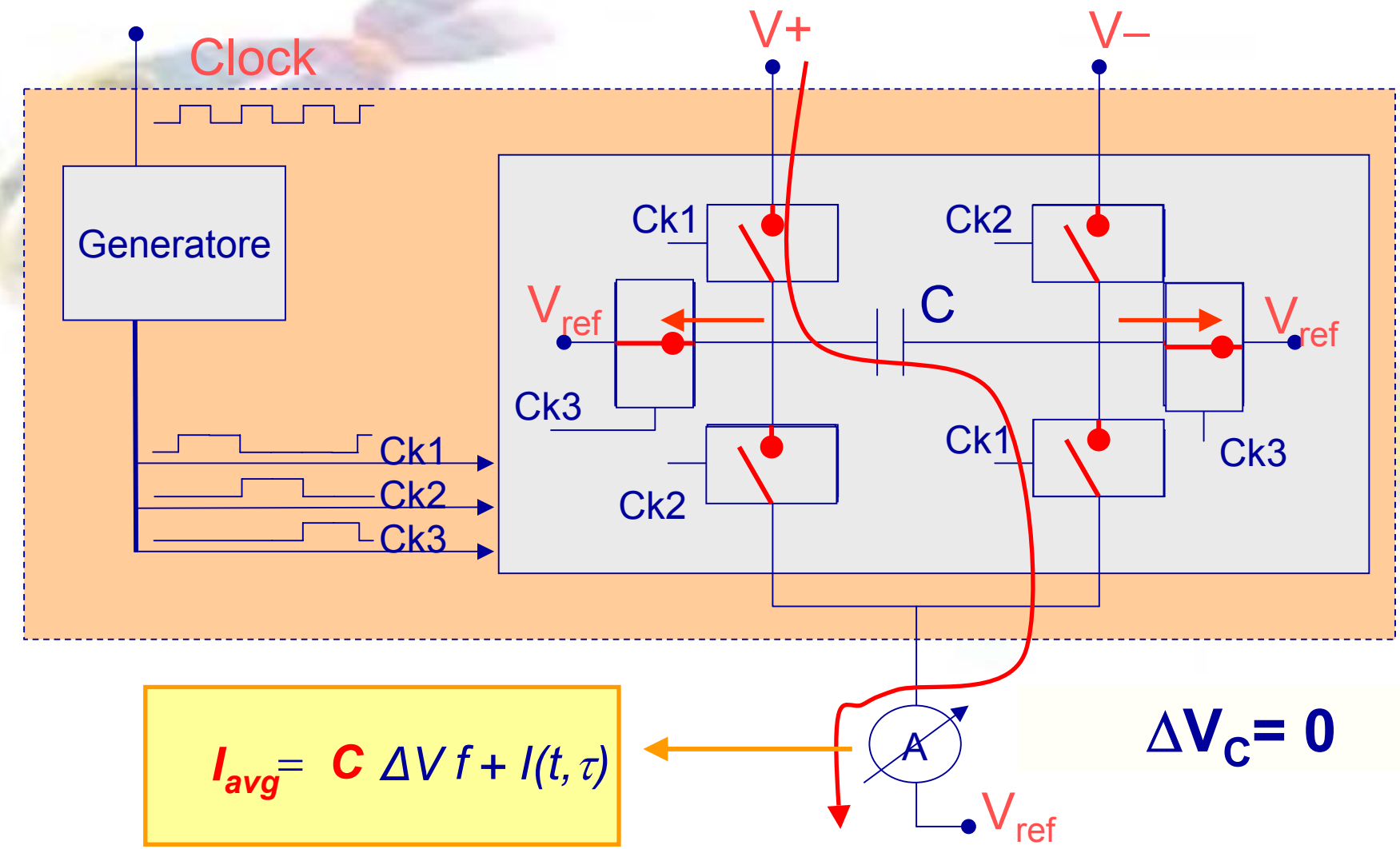
Two pulses (I)


V+
Out
CHIP
Ck1
Ck2
Ck1
Clock
Generatore
C
Ck2
Ck2
Ck1
A
V_{ref}
Switch (pass transi
$I_{avg} = I_{DC} + C\,\Delta V\,f_{clock}$

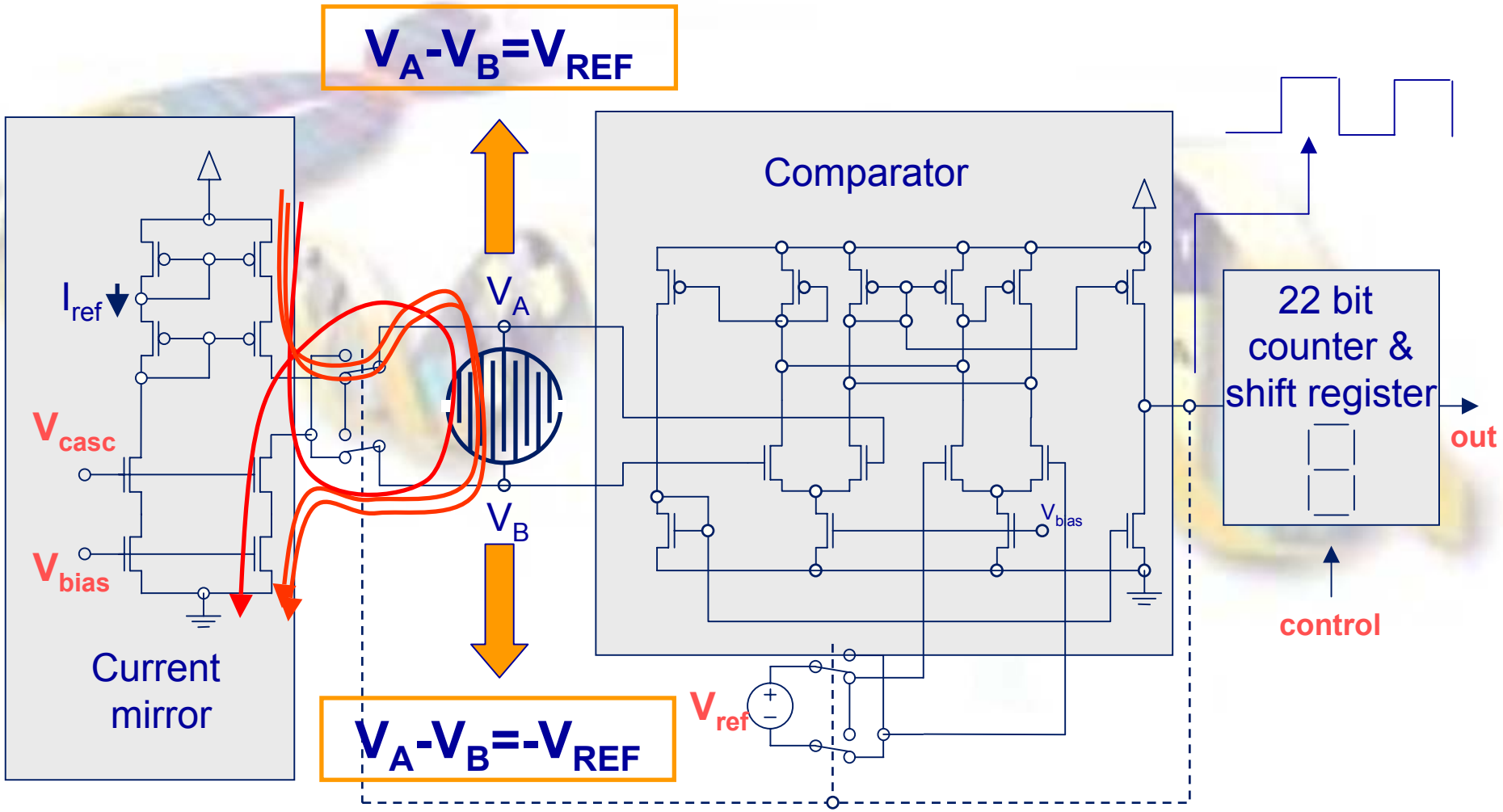
Two pulses (II)



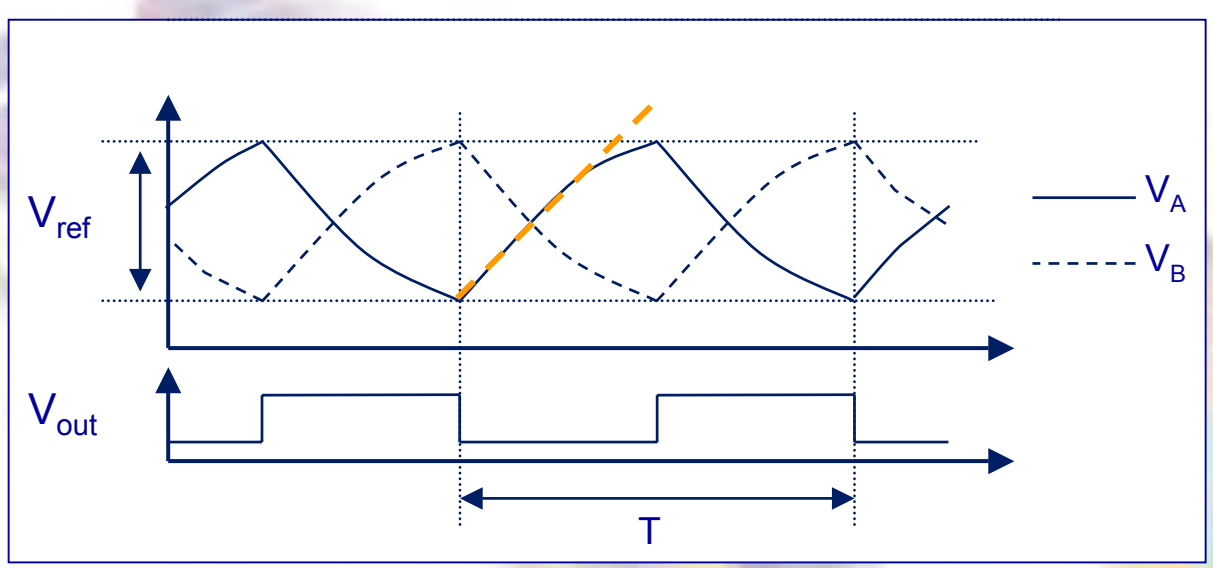
Three pulses



Array: pixel circuits



Array: C to f conversion



$$T = 2R_{sensor}C_{sensor}\ln\frac{1}{1-\frac{V_{REF}}{I_{REF}R_{sensor}}}$$

Linear behavior

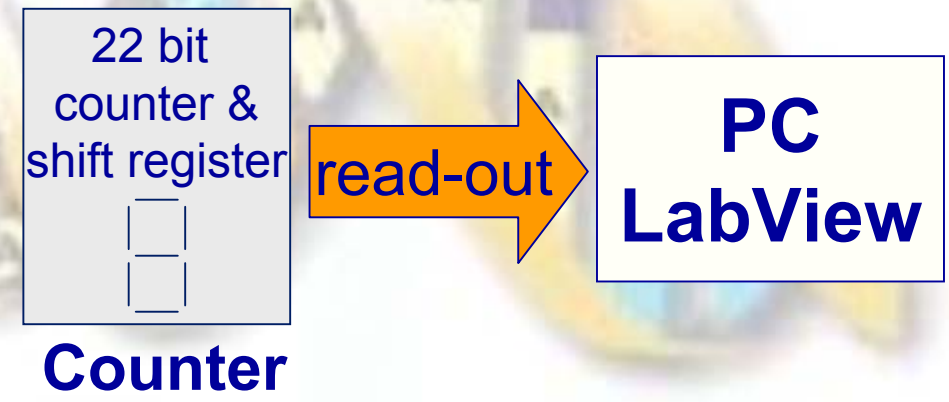
$$T = \frac{2 \cdot V_{REF} \cdot C}{I_{REF}}$$

Array: set-up

Input

- Measuring time
- Mirror Current
- Vref
- Address

Output



Electrical measurements