



# HPK L1 teststructures



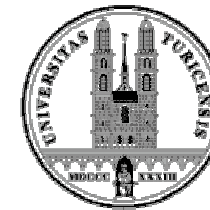
- HPK L1 half moon teststructure
- corresponding to main chips 6,7
- Results on
  - Diode C-V
  - Coupling capacitors
  - polysilicon arrays
  - Strip capacitances
  - MOS



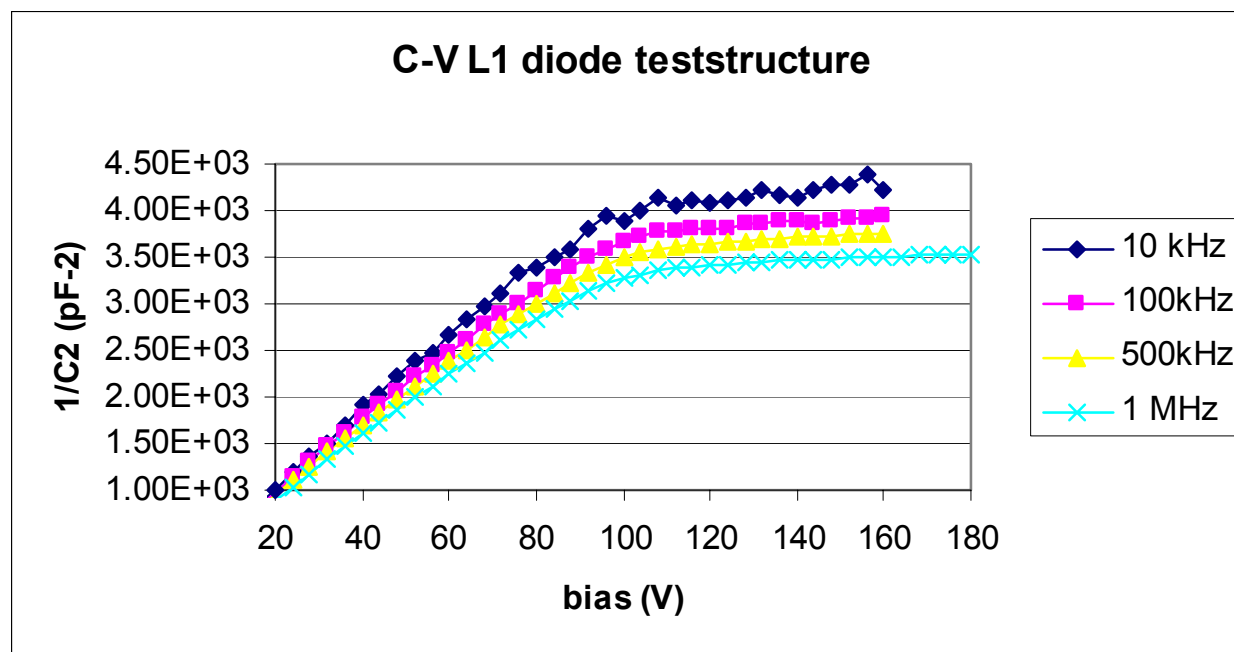
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4/3/03



# HPK L1 teststructures



- depletion voltage of diode  $\sim 110\text{V}$
- Corresponding sensor (HPK-L1 #6,7) depletion voltages:
  - 150V (HPK)
  - 130V (KSU), 110V (FNAL)
  - N.B. depletion voltage of segmented strip detector is  $\sim 5\text{-}10\%$  higher than planar diode

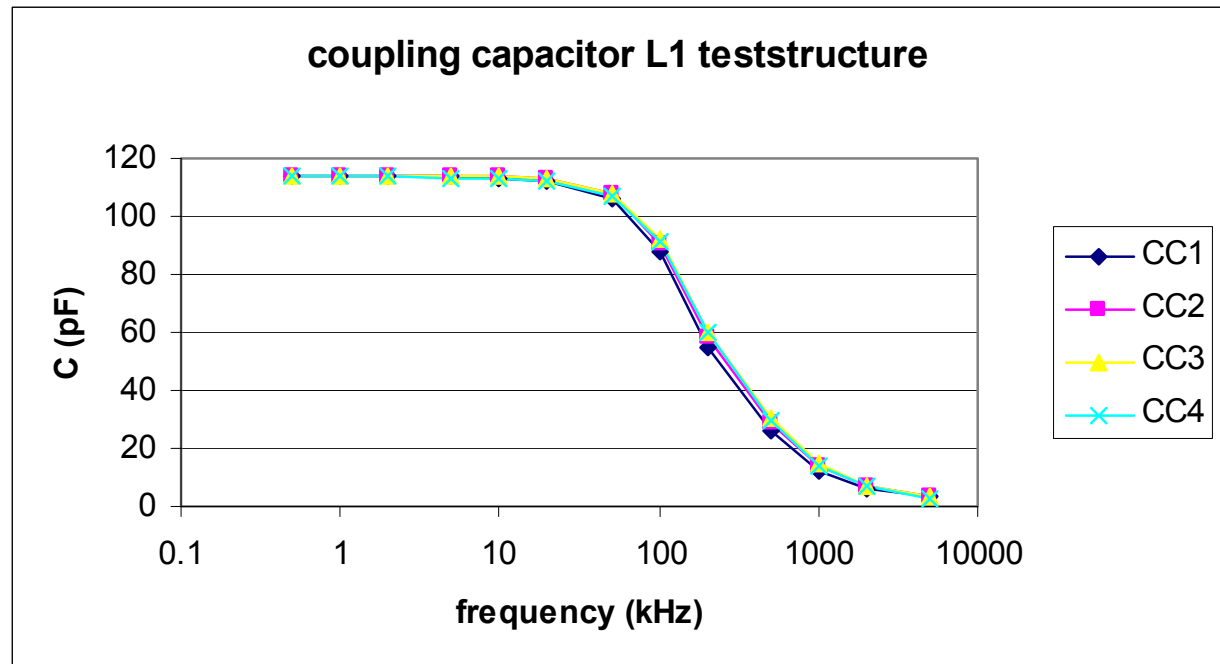




# HPK L1 teststructures



- coupling capacitor test structure
- same length than on sensor: 7.74 cm
- low frequency limit: 115 pF => 14.8 pF/cm (in specs)

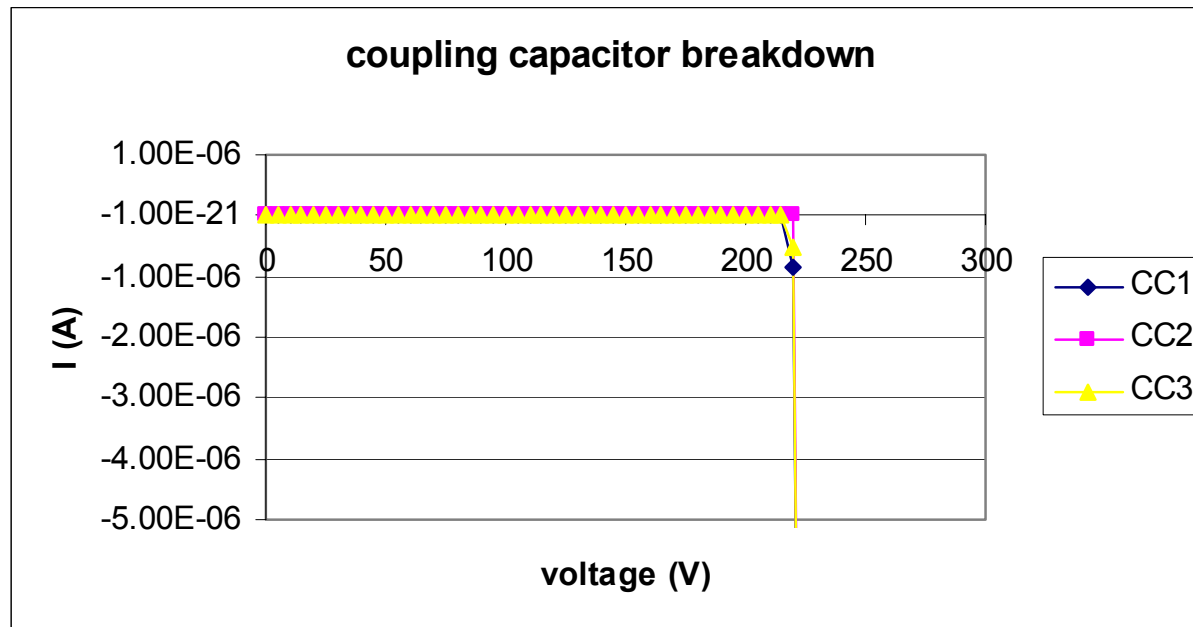




# HPK L1 teststructures



- CC breakdown ~220-230 V
- similar to HPK-L2

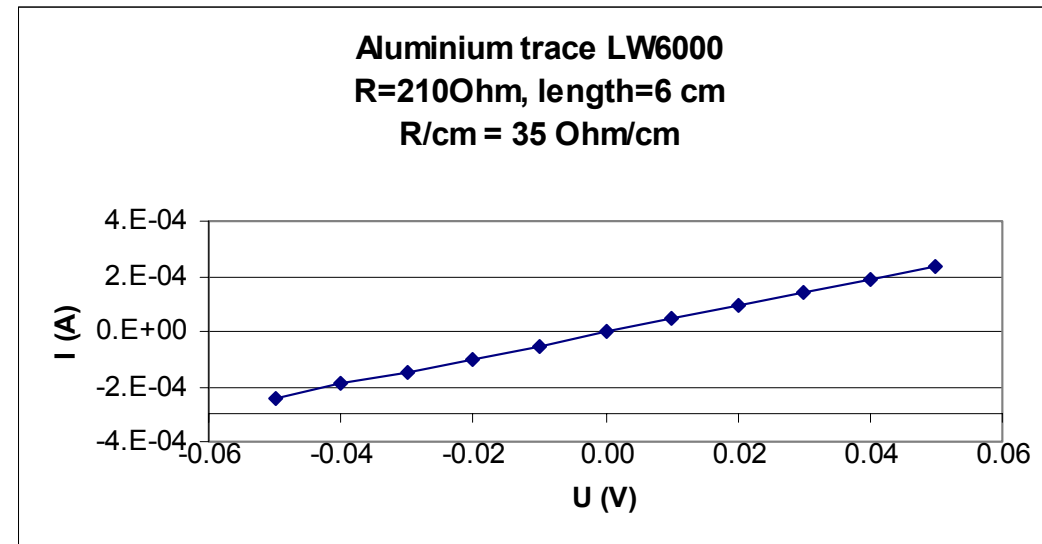
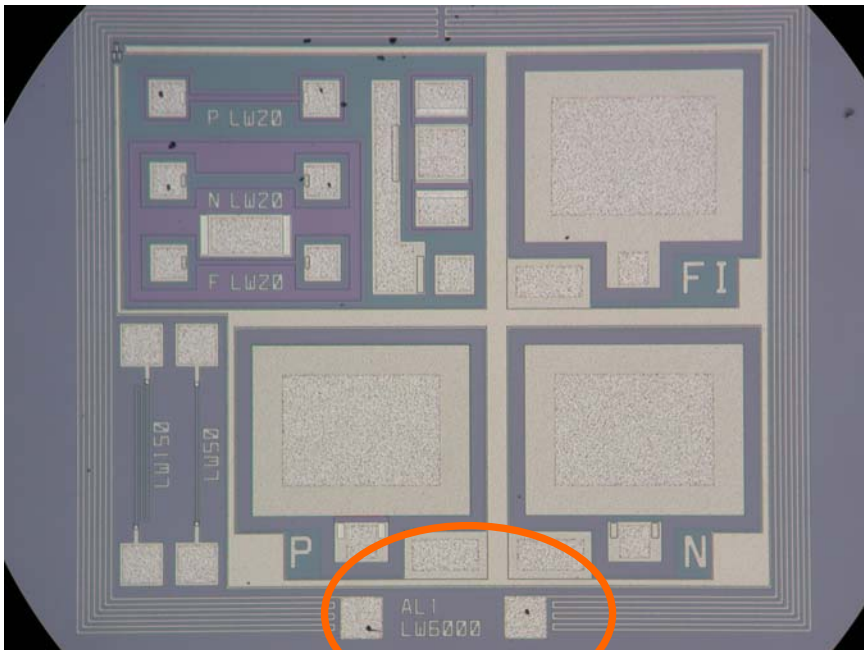




# HPK L1 teststructures



- Aluminum trace teststructure (meander-like)
- length 60 mm
- resistance: 35 Ohm/cm (spec: 30 Ohm/cm)
- HPK-L2: 16 Ohm/cm, smaller due to wider Al traces

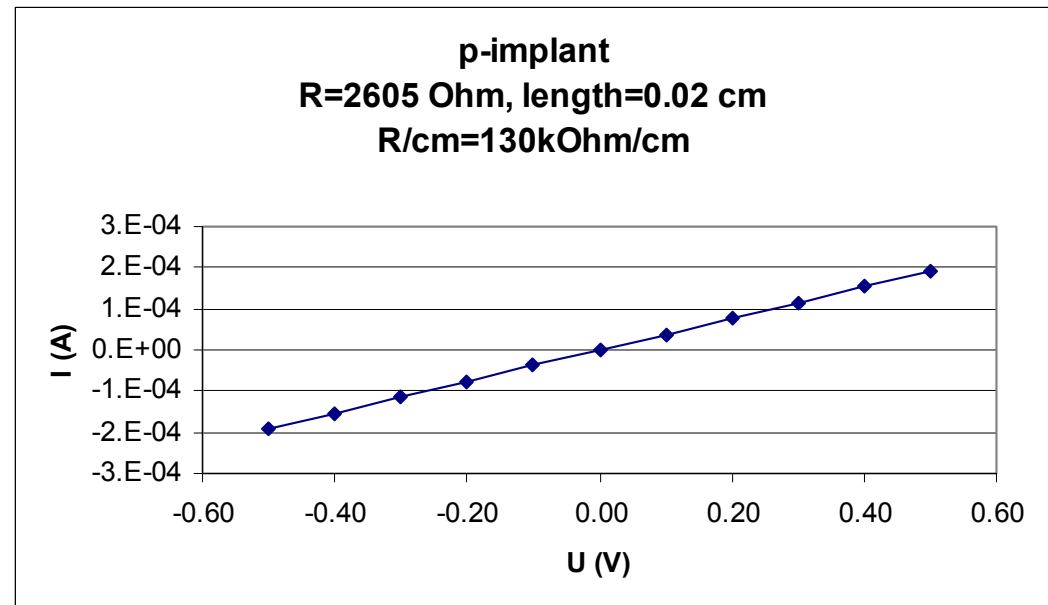
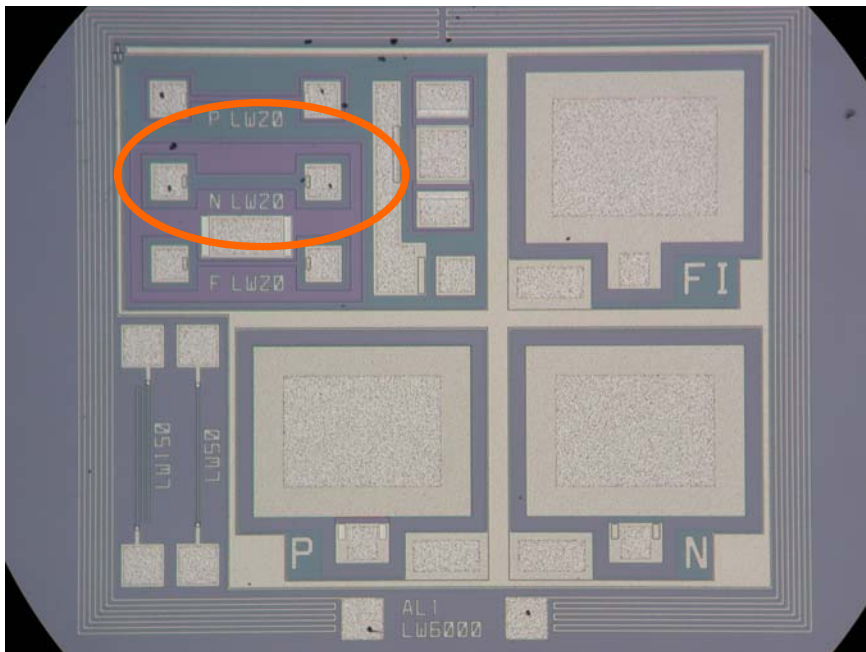




# HPK L1 teststructures



- p+ implant structure
- 130 kOhm/cm (on HPK-L2: 104 kOhm/cm)

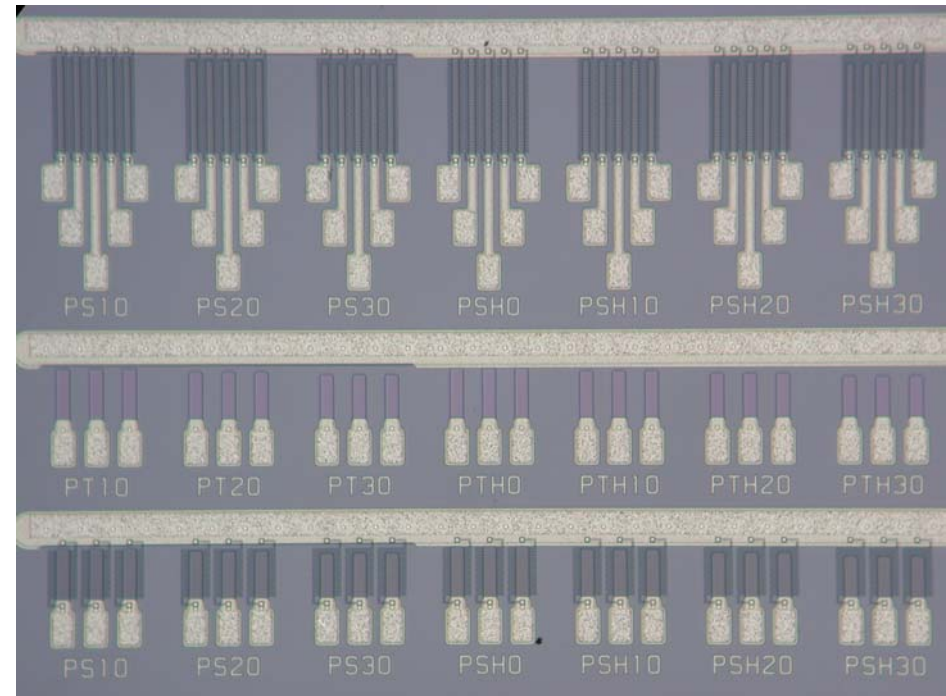




# HPK L1 teststructures



- numerous polyresistor structures
- different arrays: PS0, PS10, PS20, PS30 and PSH0 - PSH30
- What is the difference?
  - polysilicon material?
  - Processing?
  - doping?

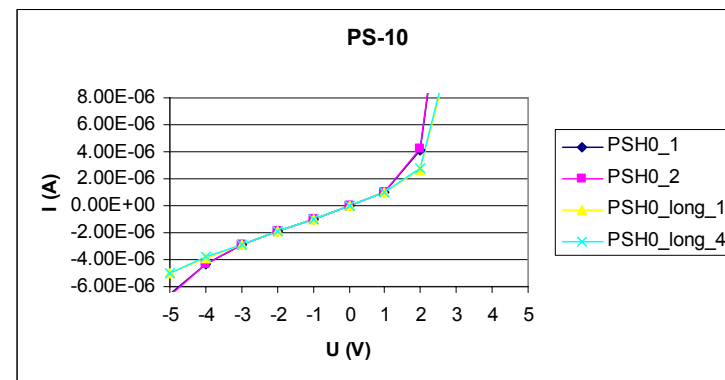
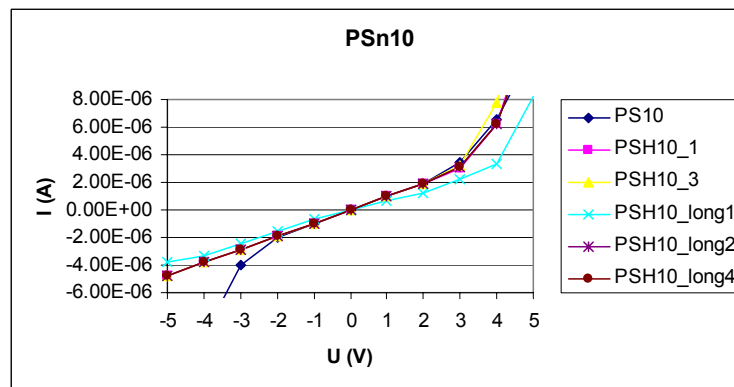
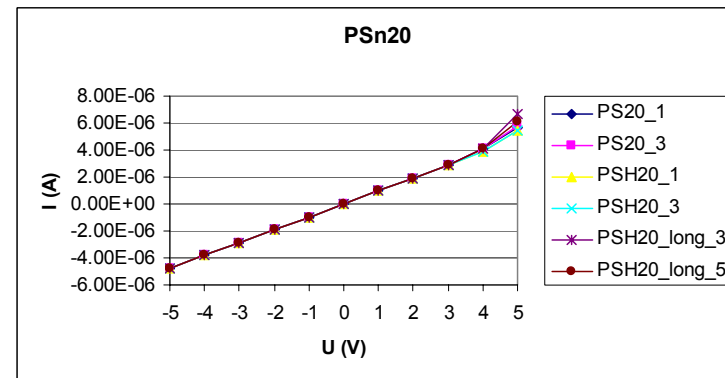
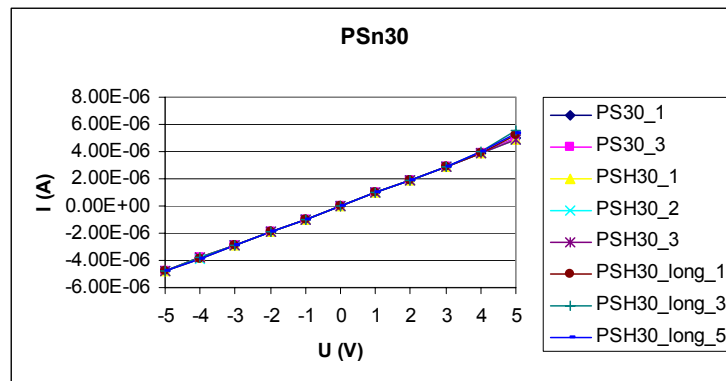




# HPK L1 teststructures



- linearity from in range from -5V to +5V given for PS-30 and PS-20 resistor array
- PS-10 and PS-0 have breakdown at  $\pm 2V$
- in linear region all resistors measured to be  $1.05 \pm 0.01$  Mohm



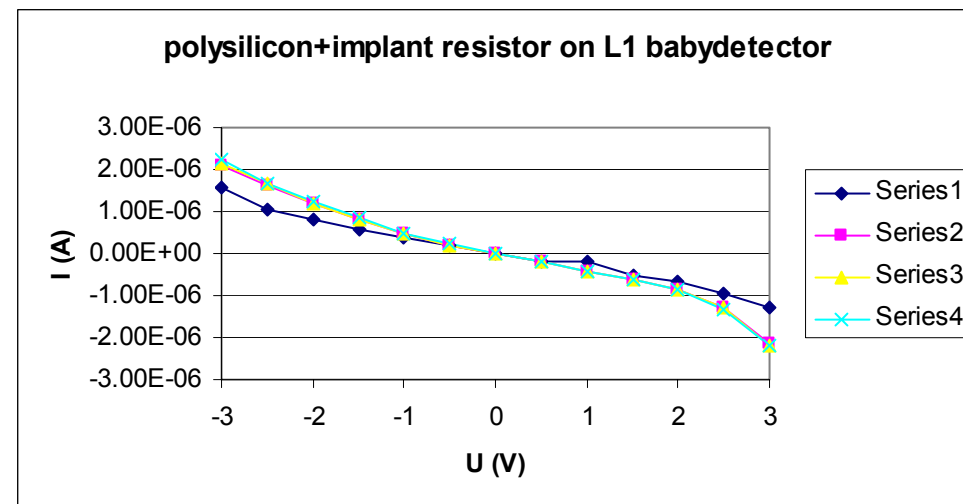
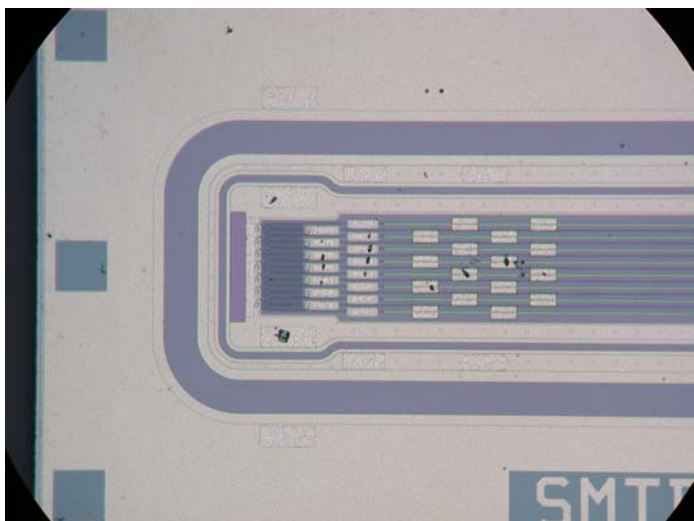
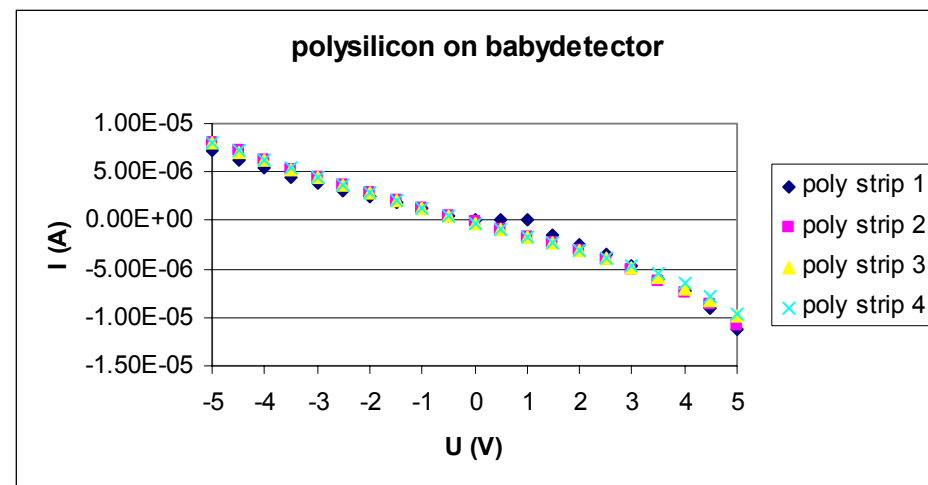




# HPK L1 teststructures



- Baby detector w/ polysilicon resistors
- $R_{\text{poly}}$ :  $0.7 \pm 10\%$  Mohm
- $R_{\text{poly}} + R_{\text{implant}}$ :
  - $1.5 \pm 10\%$  Mohm
  - implant alone: 130kOhm/cm
    - ✓ 1MOhm implant for 7.7 cm strip
  - not fully consistent !

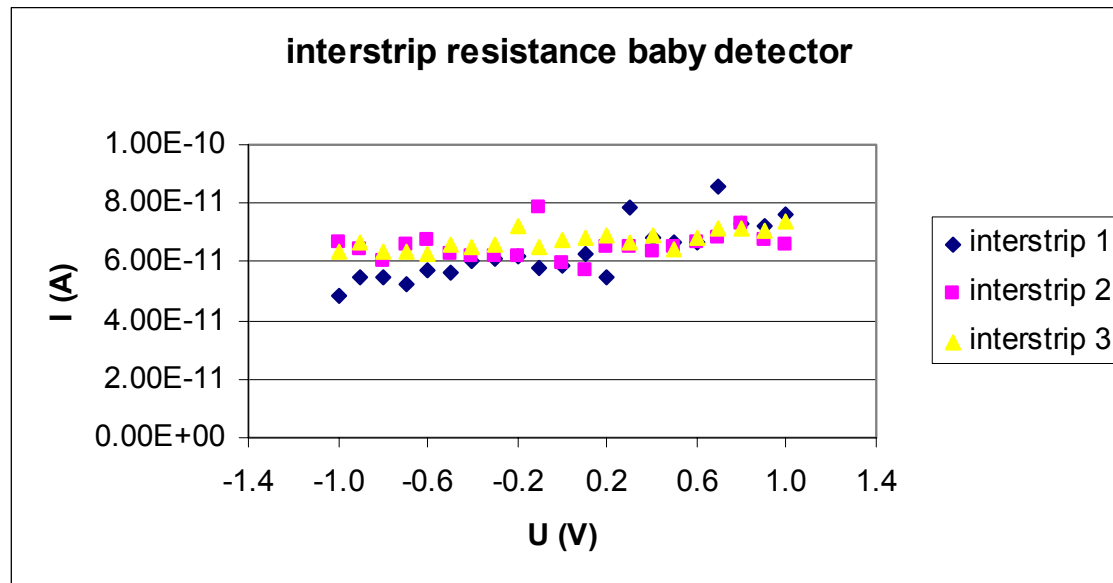




# HPK L1 teststructure



- exact resistance value is difficult to measure, currents are low
- value is irrelevant though, as long as  $R_{\text{inter}} \gg R_{\text{poly}}$
- $R_{\text{inter}}$  on babydetector  $\sim 10 \text{ Gohm}$  (?)

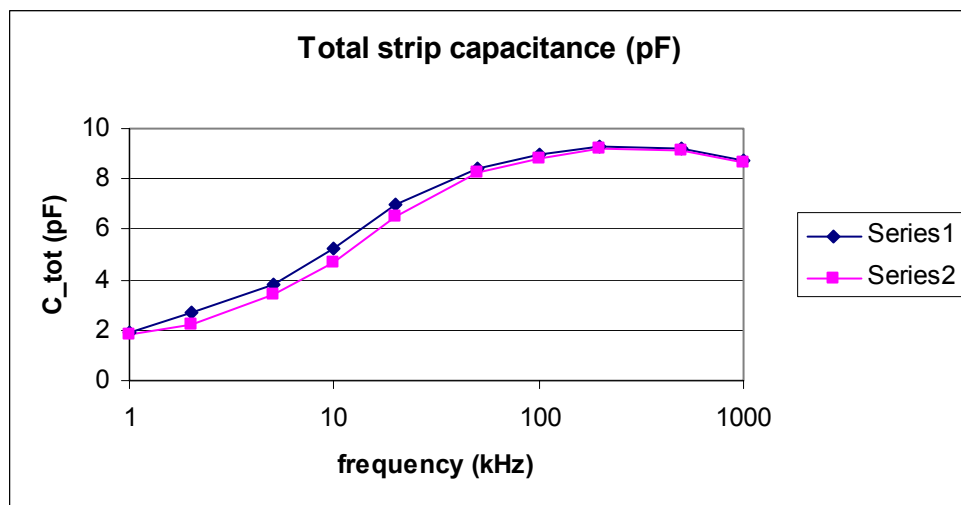
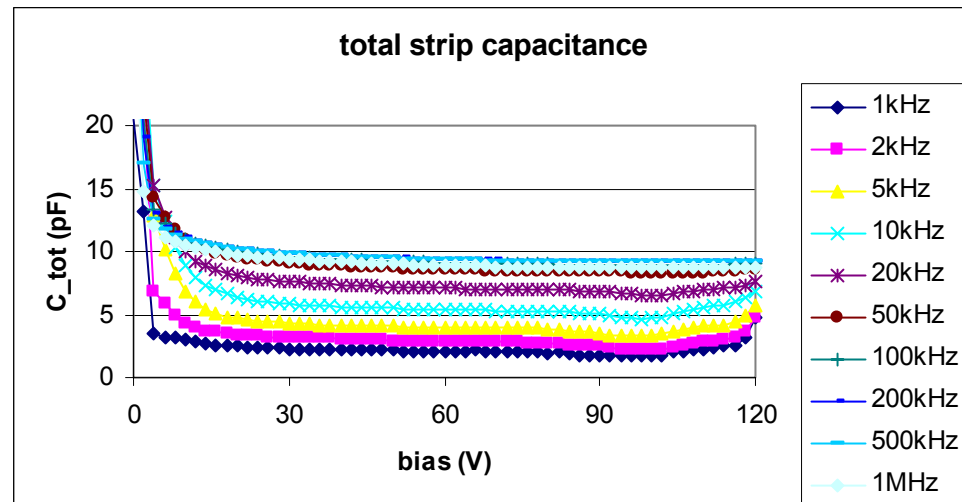




# HPK L1 teststructures



- total strip capacitance
  - includes both neighbors
  - plus backplane capacitance
- capacitance reaches plateau at  $\sim 10V$
- frequency dependence:



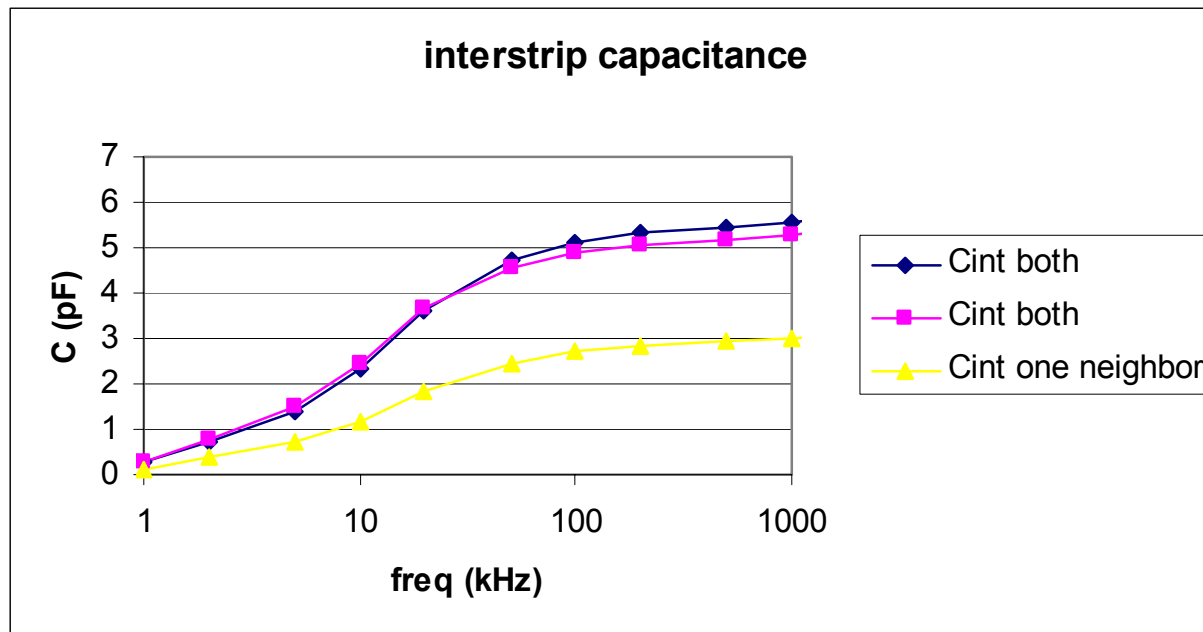
Capacitance at 1 MHz:  $\sim 8.5pF$   
Cap/cm:  $\sim 1.1 pF/cm$



# HPK L1 teststructures



- interstrip capacitance
  - to one neighbor:  $\sim 3 \text{ pF} \Rightarrow 0.39 \text{ pF/cm}$
  - to both neighbors:  $\sim 5.5 \text{ pF} \Rightarrow 0.71 \text{ pF/cm}$





# MOS structure



- MOS (metal-oxide-silicon) structure
  - measure flatband voltage
  - use only 0.1V oscillator amplitude on LCR
  - high frequency (200kHz)
  - flatband shift to negative values?
  - interpretation not yet clear

