CAP7: electronics tests

1st Open Meeting of the SuperKEKB Collaboration
PXD session

H. Hödlmoser, M. Cooney, J. Kennedy, H. Sahoo
University of Hawaii

Y. Arai - KEK
M. Ohno - OKI Semiconductor

Contents

CAP7 summary

- CAP7: follow up of CAP4/CAP5 in SOI, received 11/2008
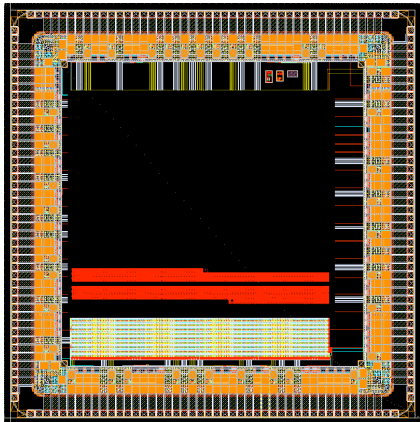
Leakage current

NMOS characteristics under HV

Test structures of on-pixel logic

- RS flip-flop
- D flip-flop
- Comparator

Summary/outlook
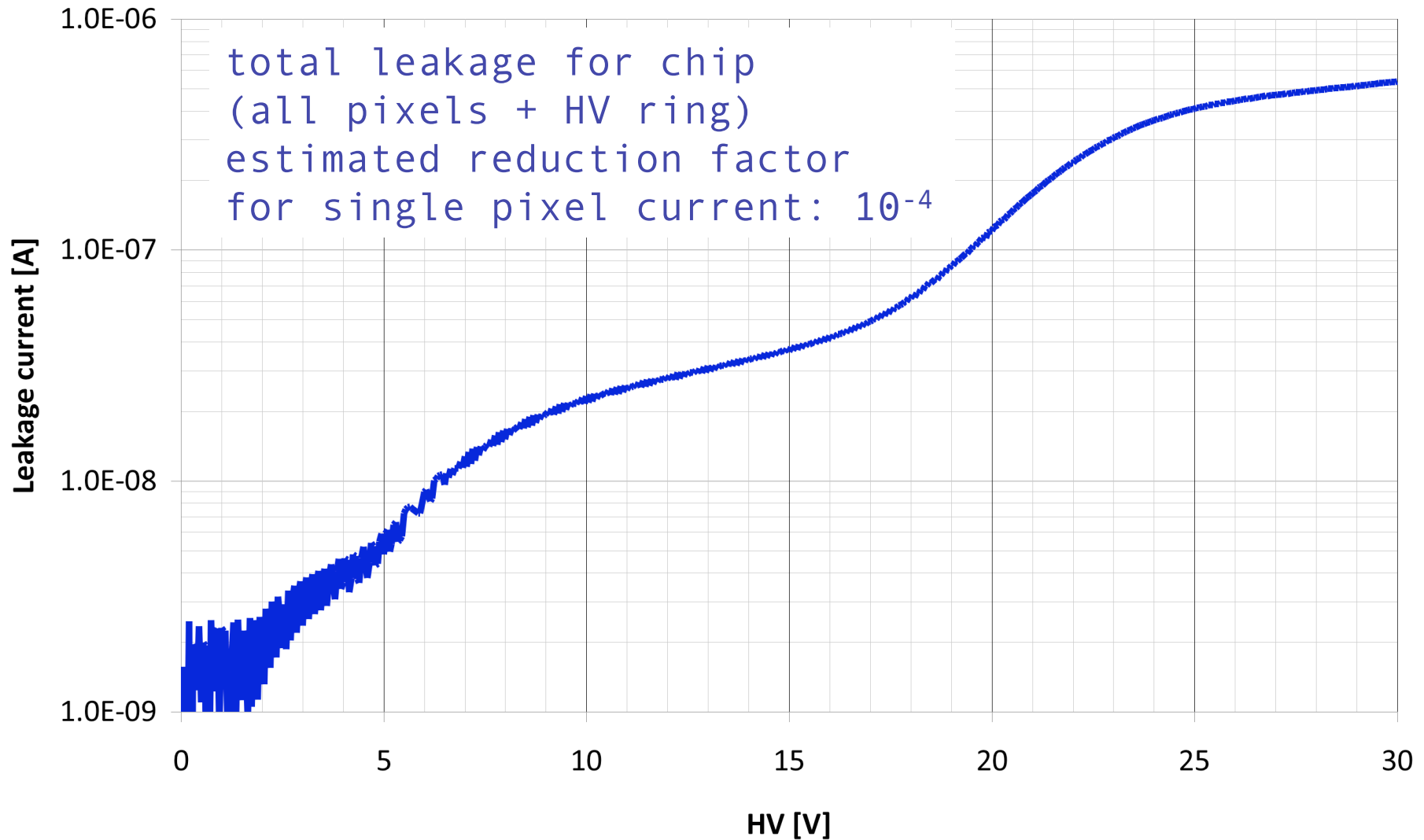
CAP7 design in .2 μm OKI SOI

- binary design as in CAP4/5 for 2008 OKI MPW SOI run
- transparent latch replaced by d-flip flop (no chatter)
- submitted 1/2008
- delayed due to fabrication issue
- final chip received late 11/2008 beginning 12/2008

- electronic tests of unpackaged die on probe station:
    - total leakage current of chip: 20 nA @ 10V HV
    - bare nmos transistor: treshold shift of 65 mV @ 20V HV
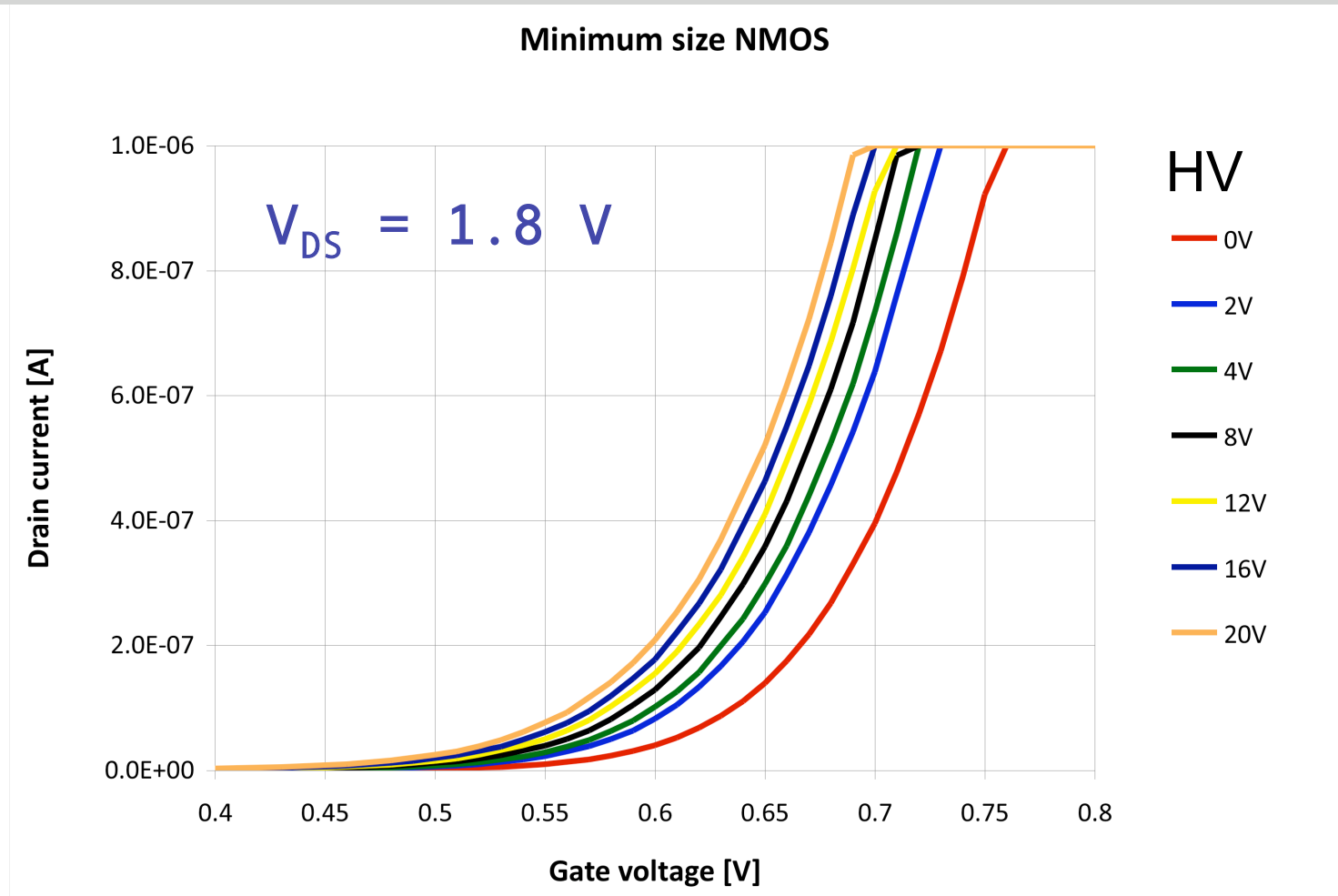   - on pixel logic: RSFF, DFF, Comparator;

total dimensions: 5mm x 5mm
active area: ~3mm x ~3mm
total pixels: 6000
pixel cell: 35x50 μm^2
test structures   each sub-component
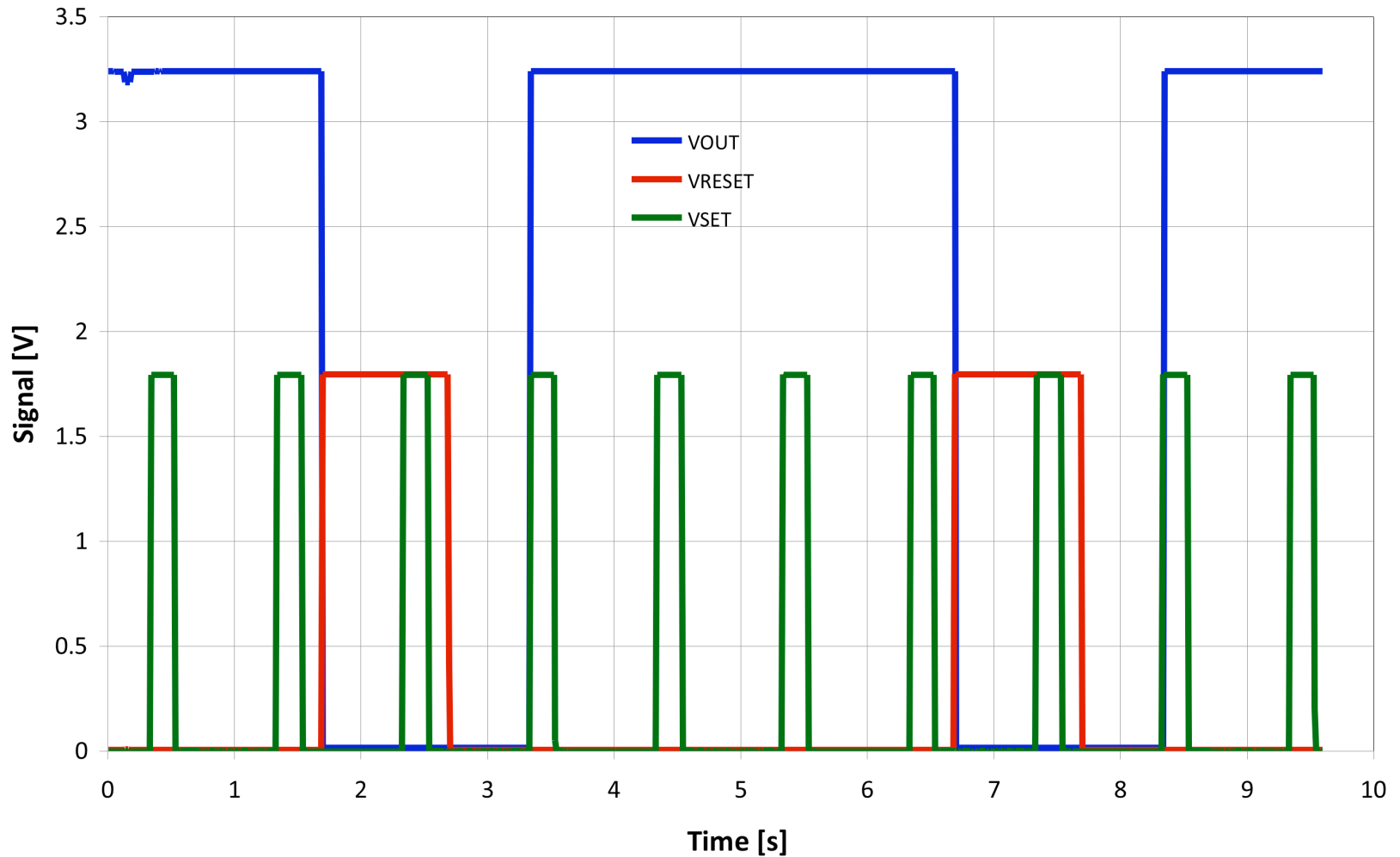
designed by M. Cooney

Leakage current

total leakage for chip
(all pixels + HV ring)
estimated reduction factor
for single pixel current: 10^{-4}

Leakage current [A]

HV [V]

NMOS Characteristics under HV

Minimum size NMOS

V_{DS} = 1.8 V

HV
- 0V
- 2V
- 4V
- 8V
- 12V
- 16V
- 20V

Y-axis: **Drain current [A]**
X-axis: **Gate voltage [V]**

isolated test structure
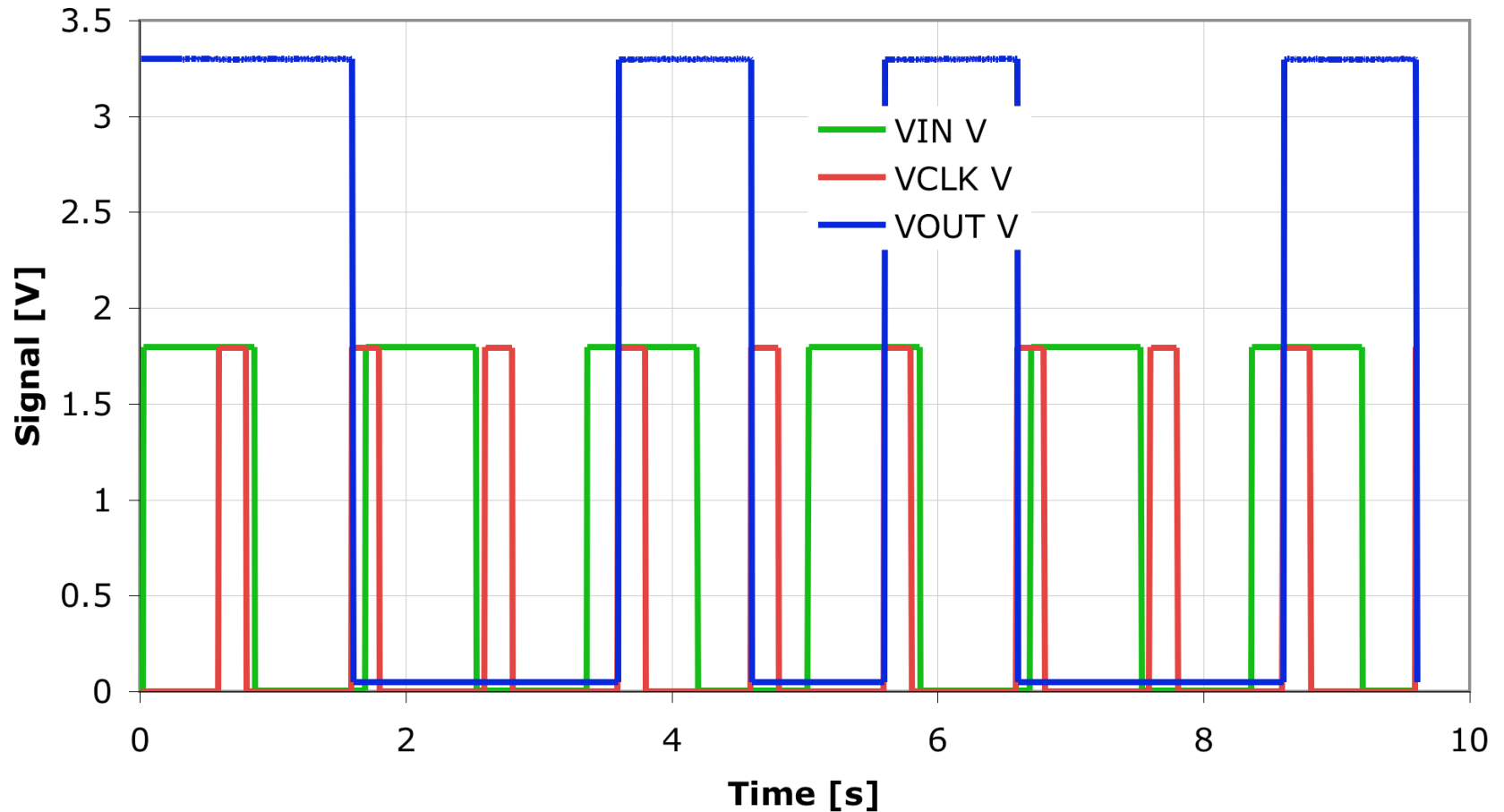threshold shift: 65 mV at 20 V
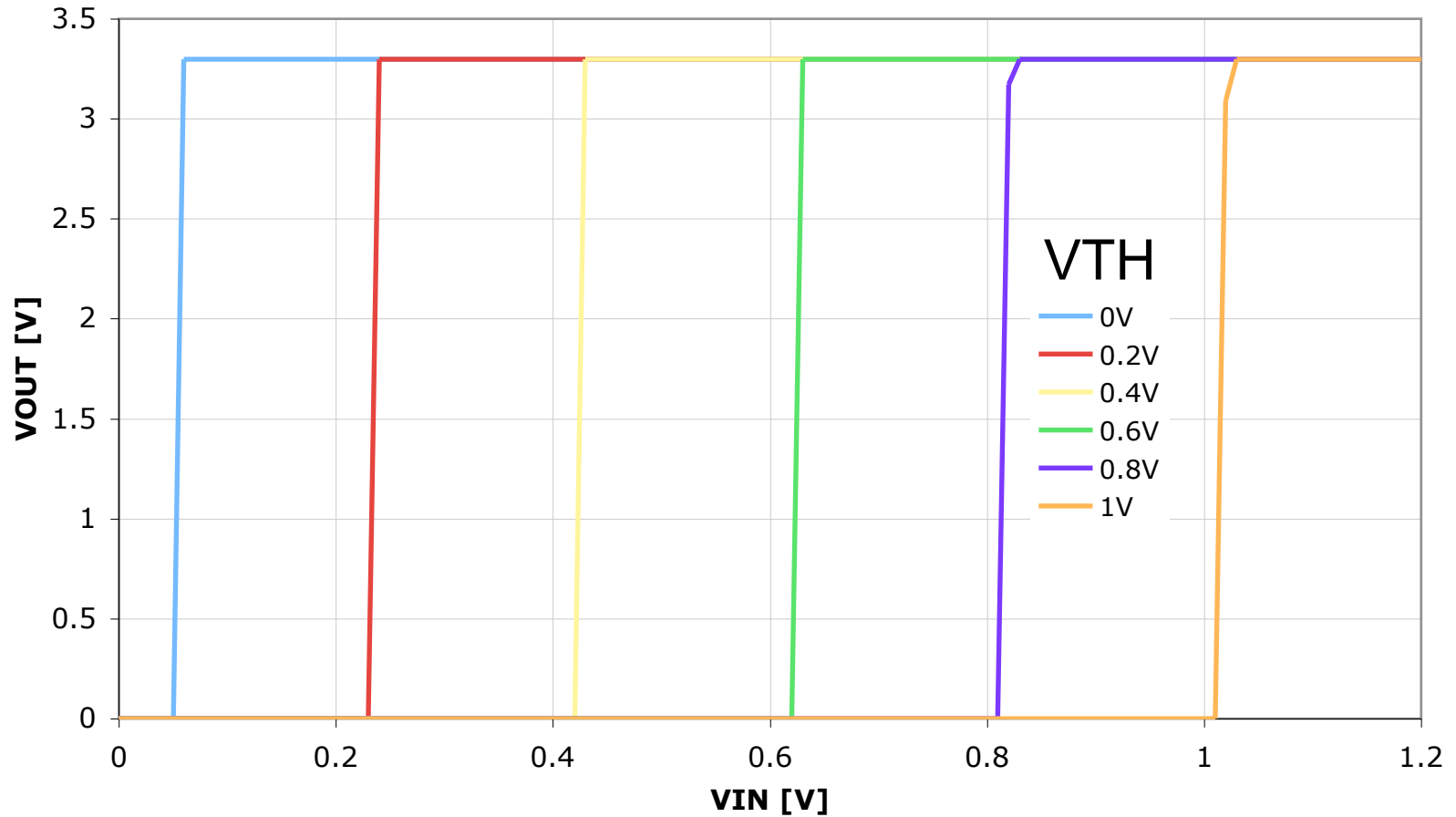
RS flip-flop

HV = 40V

D flip-flop

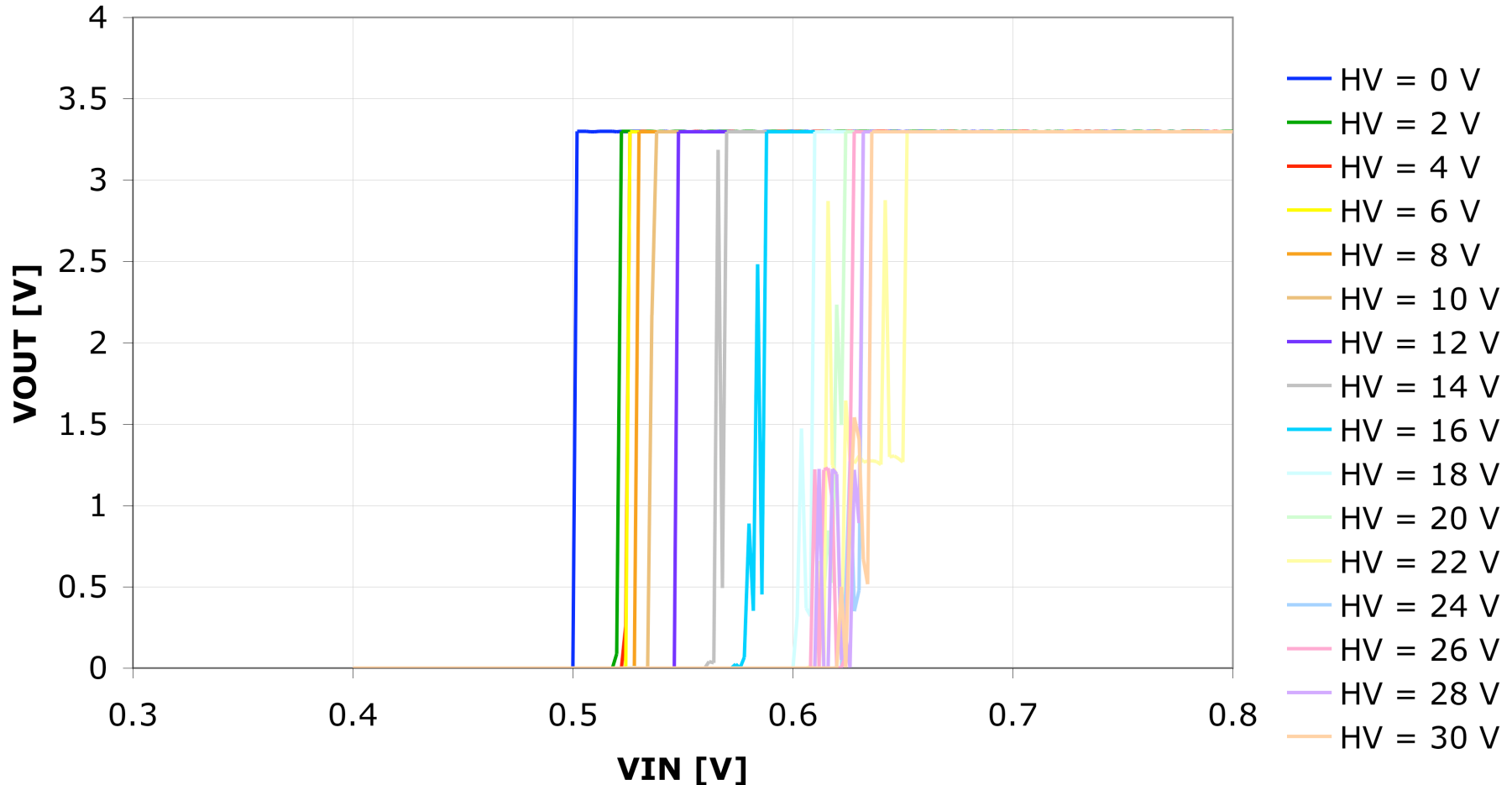**HV = 10V**

updating errors for larger HV? (updates at falling edge)

Comparator: threshold scan

Threshold Scan @ HV = 5V
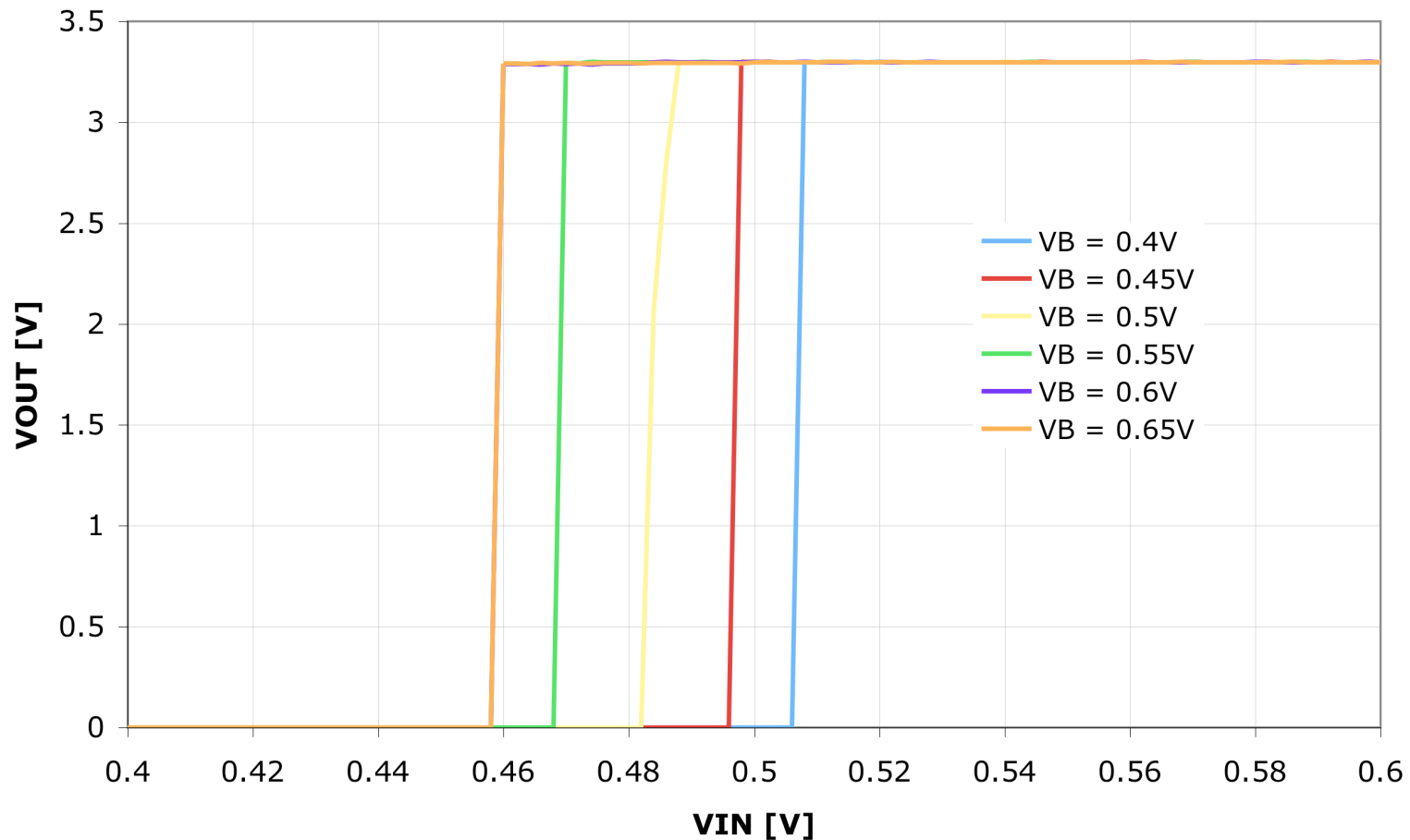VB=0.4 V

Comparator: back-gate effect

Comparator output for fixed VTH = 0.5 V and varying HV

Comparator: bias scan

variation of the turn-on with comparator bias

Comparator: VB scan for fixed HV = 0V and VTH = 0.5 V

Summary and outlook

- received unpackaged version of CAP7 last week

- carried out electronics tests on probe station

- leakage current: slightly higher than CAP5
  need to cross check on packaged version

- digital logic (DFF, RSFF) seems to work fine, also at
  medium – high HV.

- comparator:

    + comparator works (did not work at all in CAP5)
    - threshold is rather sensitive to HV

- packaged dies due to arrive tomorrow

- readout board, firmware and software ready for testing