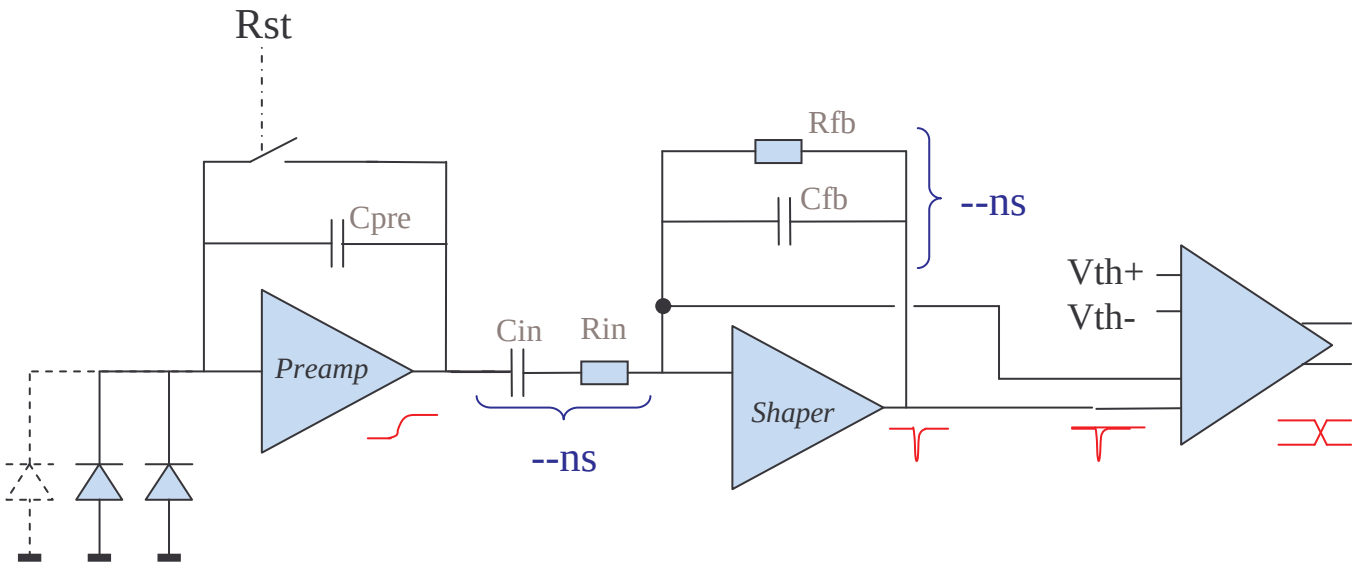
Tera-Pixel APS for CALICE

Progress

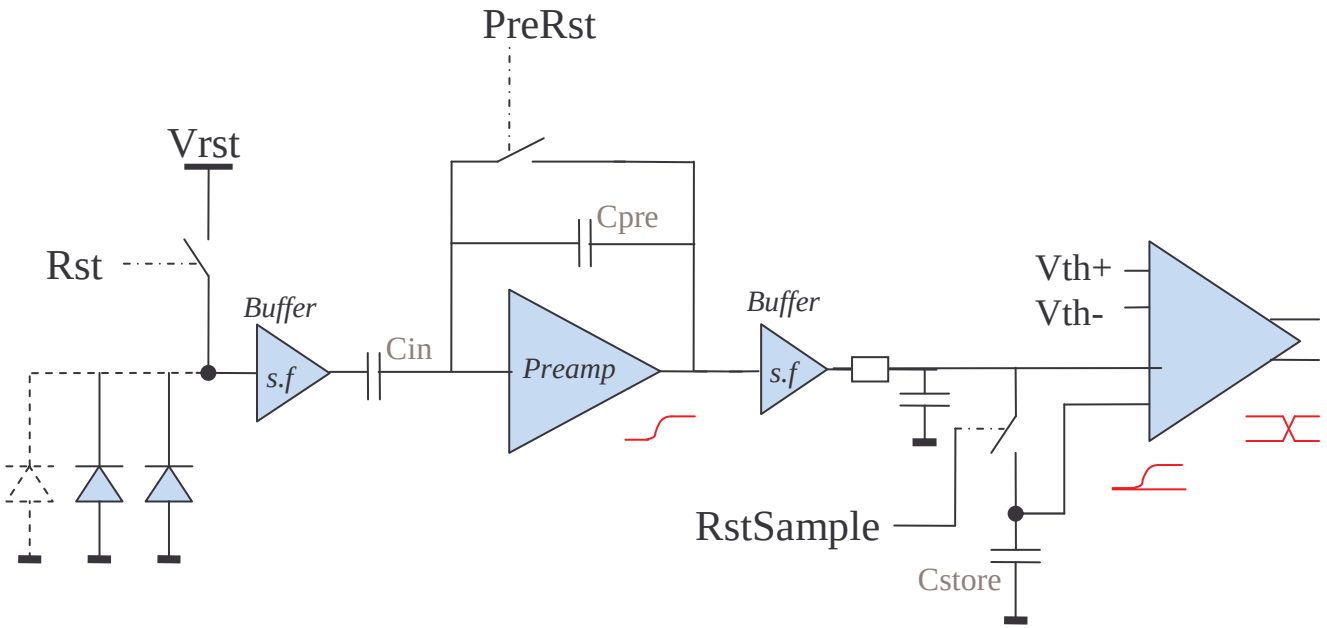
13th November 2006

PreShape Pixel



New

PreSample Pixel



PreShape Pixel

Preamp	Source Follower	Shaper	Comparator (in-pixel)	Comparator (off-pixel)
1.8v	-	1.8v	1.8v	1.8v
4.5uA	-	1.0uA	0.5uA	0.3uA
2.7uW ↓	-	1.8uW ↓	0.9uW	0.5uW

~~11.8µW~~

7.7µW

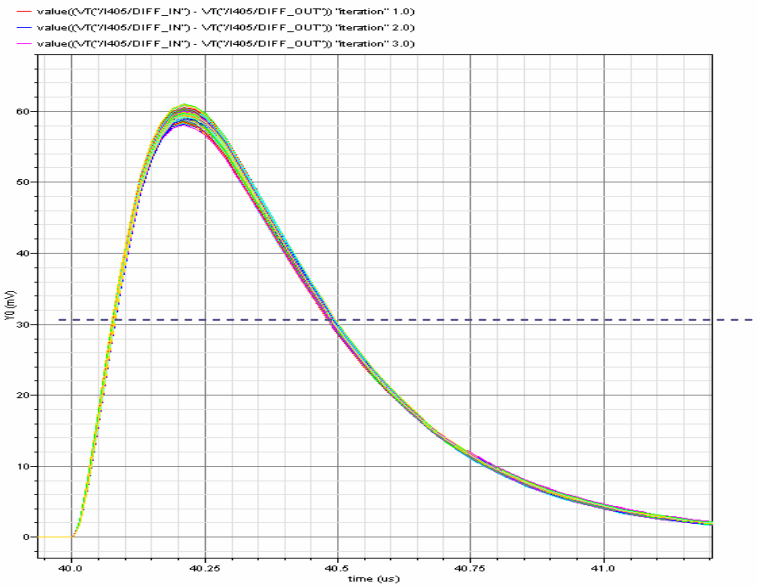
New

PreSample Pixel

Pixel Source follower	Charge (Pre)amplifier	Output Source Follower	Comparator (in-pixel)	Comparator (off-pixel)
1.8v	1.8v	1.8v	1.8v	1.8v
0.9uA	1.3uA	1.2uA	1uA	750nA
1.6uW	2.4uW	2.2uW	1.8uW	1.3uW

9.3µW

PreShape Pixel



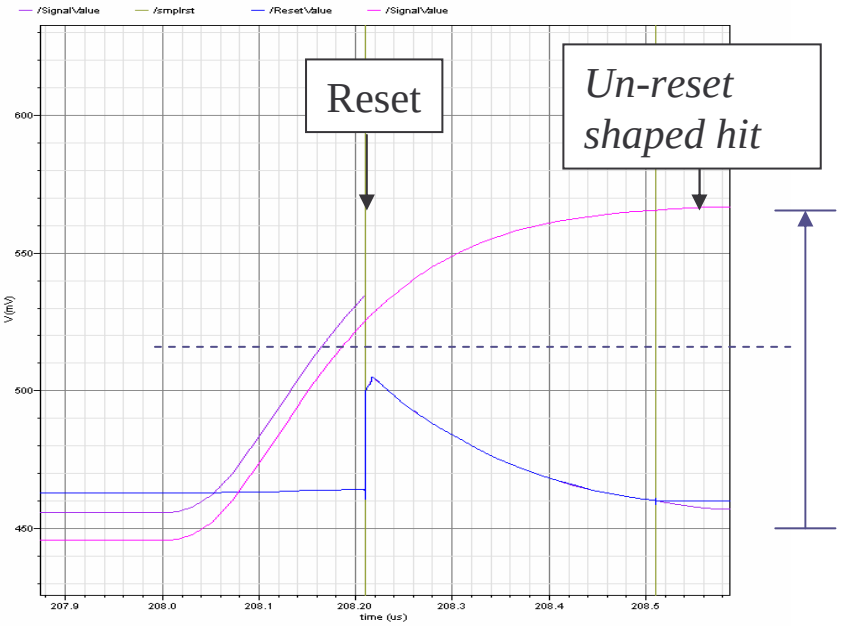
[400 electron hit]

60mV typ.

150uV/electron
(~flat up to 10,000e-
Reduces 50% by 20,000e)

New

PreSample Pixel



[400 electron hit]

120mV typ.
requires reset (~600ns)

300uV/electron
(30,000 electrons as 8 hits simulated ok)

PreShape Pixel

Transient Noise

3.5mV typ at input to comparator

~ 25 electrons

New

PreSample Pixel

Transient Noise

5.9mV typ at input to comparator

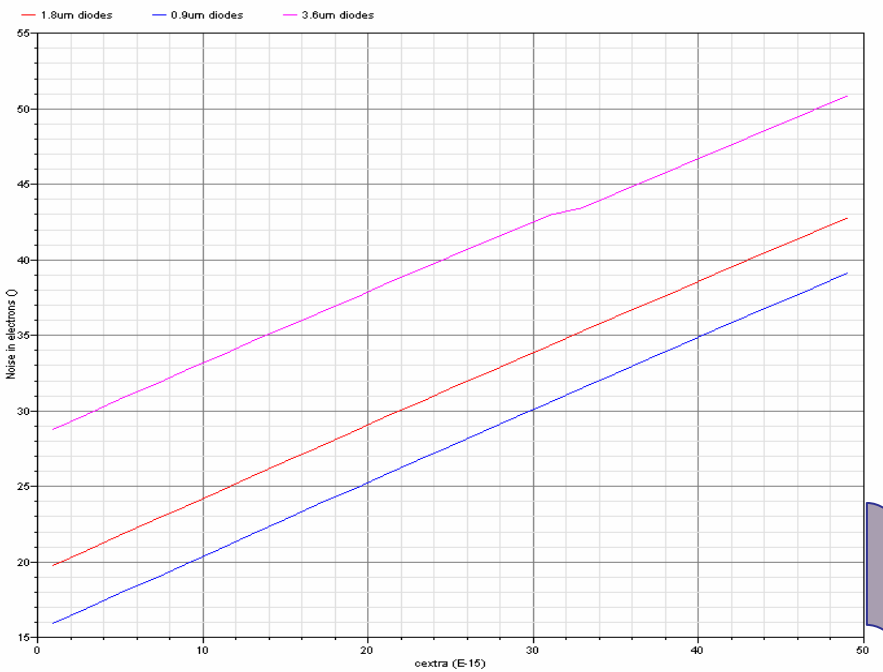
√2 = 8.3mV (√2 due to sampling)

~ 27 electrons (was 32)

PreShape Pixel

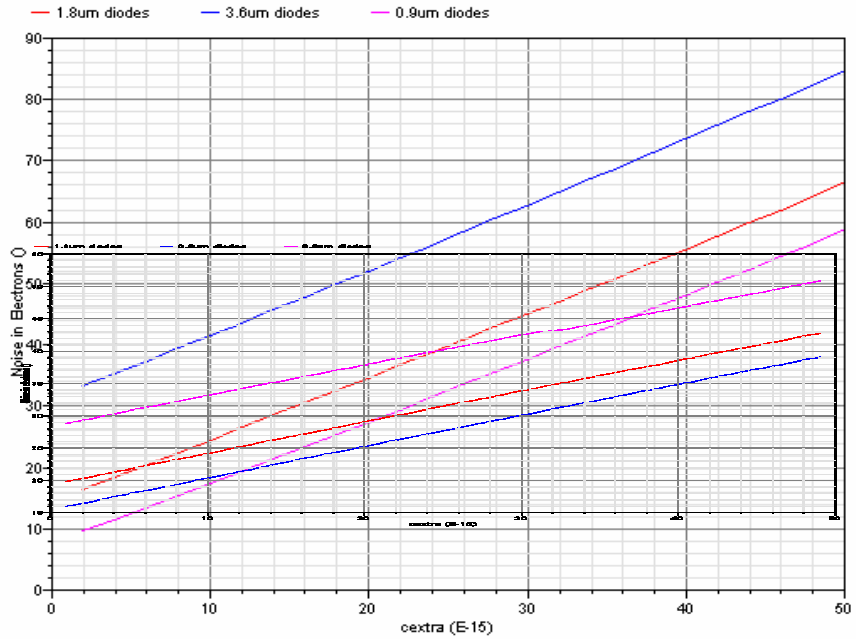
New

PreSample Pixel



Signal/Noise optimisation

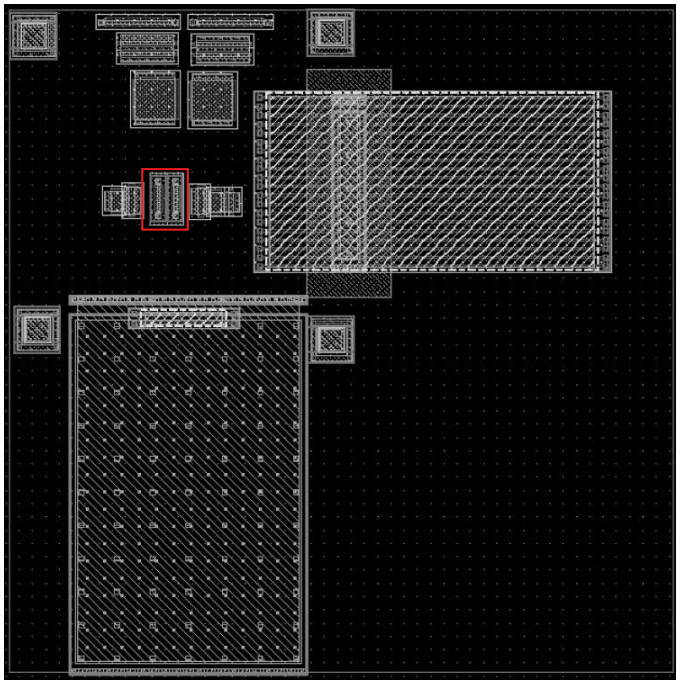
Larger diode capacitance increases noise



Signal/Noise optimisation

Larger diode capacitance decreases signal *(and therefore noise at input as equivalent charge)*

PreShape Pixel

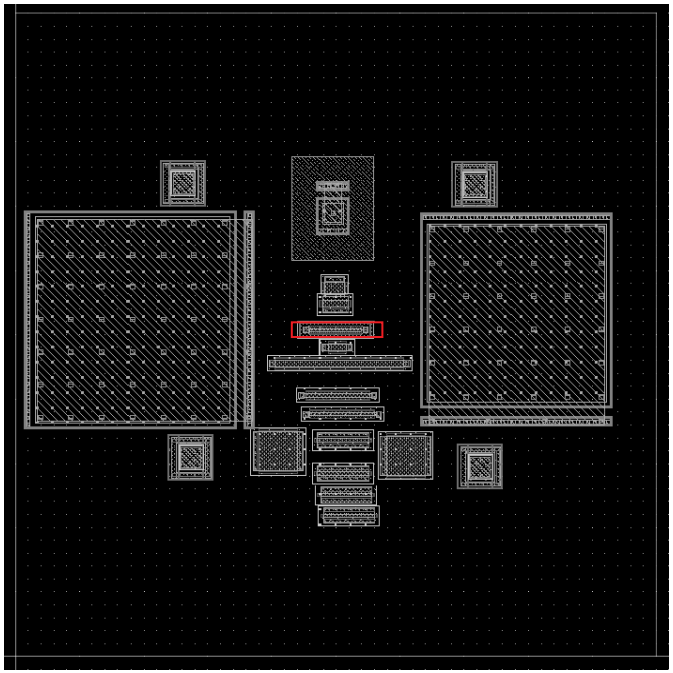


NWELL = 3 x 4 μm

New

Add 5x9μm for pmos comparator sub-circuit

PreSample Pixel



NWELL = 1.3 x 6.3 μm

PreShape Pixel

Advantages

Always active (no reset)
Shaper recovers after saturation
Below-threshold signals do not integrate on the shaper.

Risks

Cpre feedback cap

Disadvantages

Preamp integrates charge (no reset)
20,000 electrons practical max
Time-over-threshold up to 1us :
- à Needs edge-mode logic
- à Pixel is ‘dead’ during this time

>10 MIP behaviour

Saturation causes pulse elongation (dead time)

PreSample Pixel

New

Advantages

Flexible reset timing
Pixel saturation occurs >30,000e-

Risks

Cpre feedback cap

Disadvantages

Below threshold signals are still integrated by the preamplifier
Requires reset after hit
- à additional logic
- à dead time after hit

Reset sample can contain error

>10 MIP behaviour

Signals over 4000e- may be a problem *(needs investigation)*