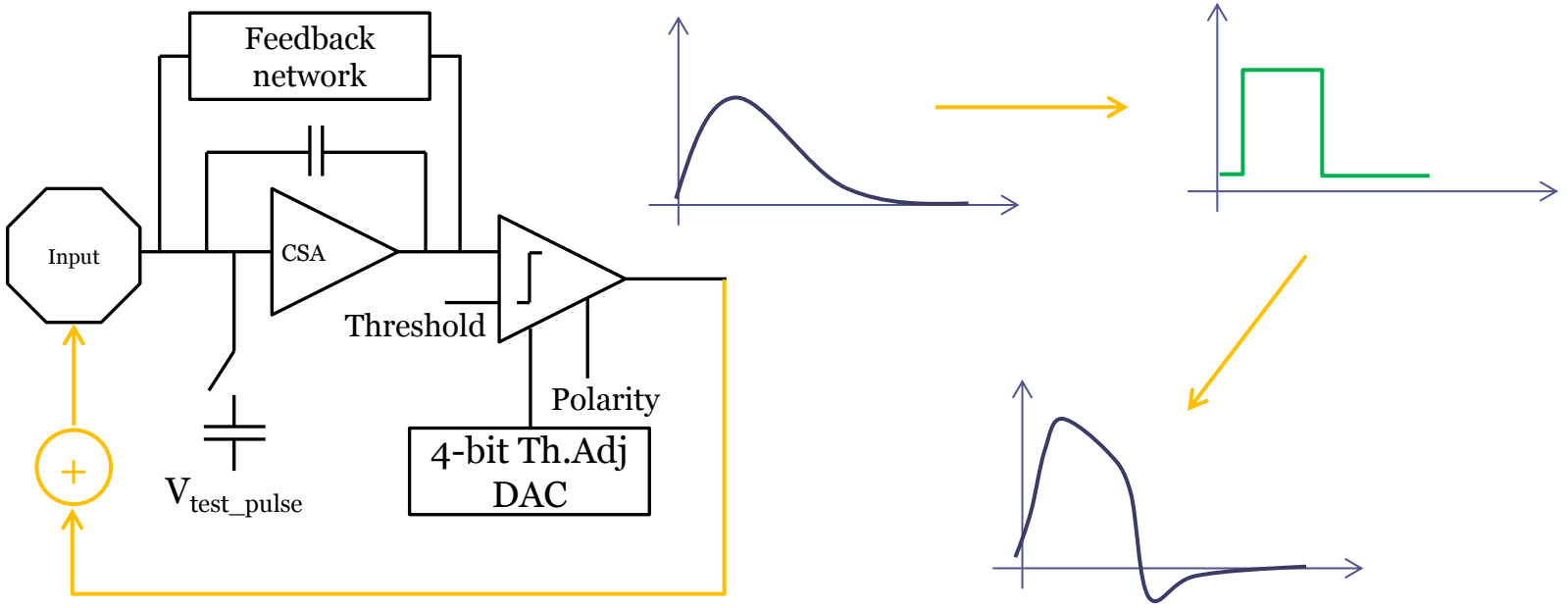
CLICpix cross-talk issue

Front-end issues

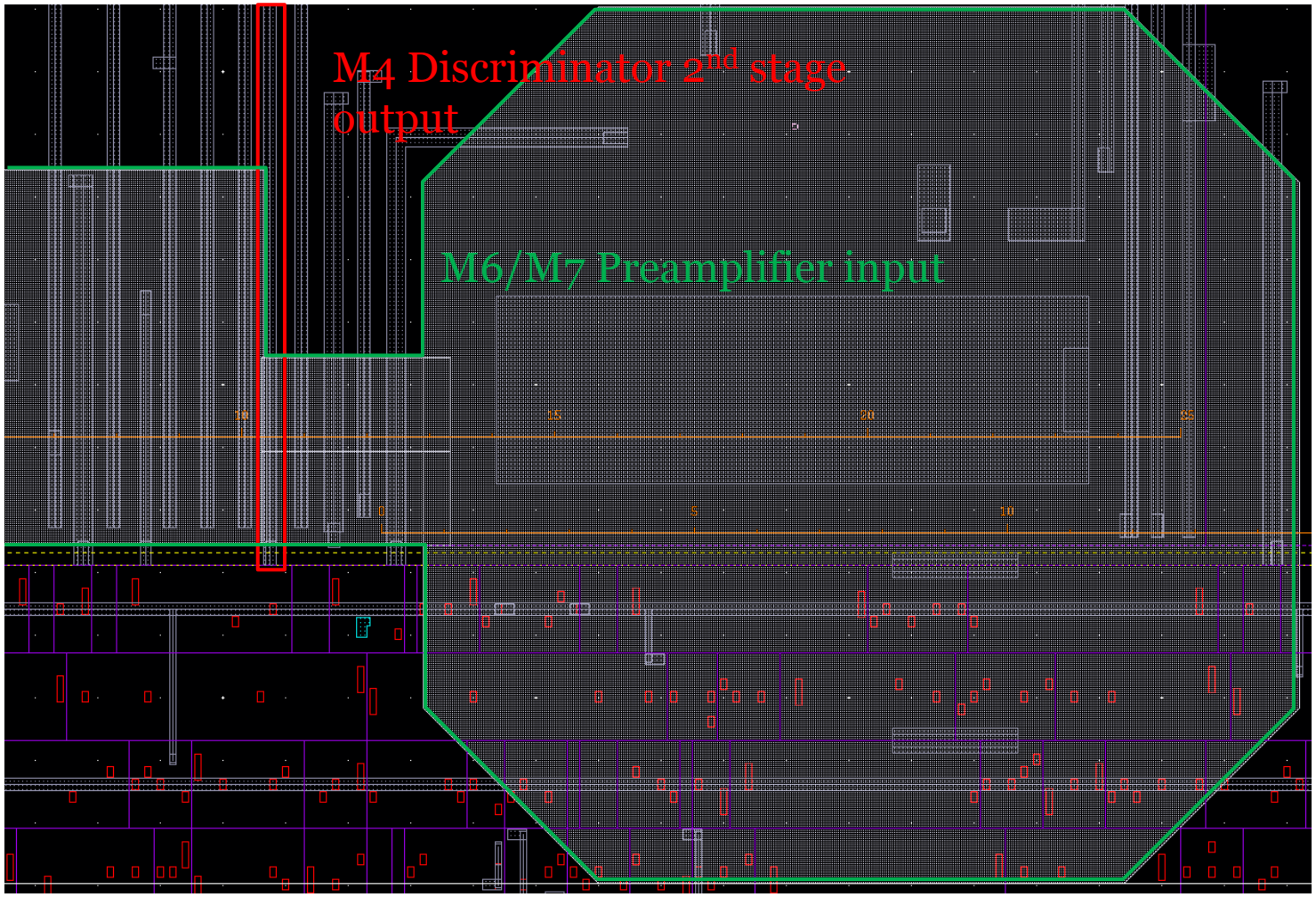
- While testing different polarities, we noticed that the S-curve measurement for one polarity (holes collection) showed a much larger noise than the other
- Moreover, the noise for pixels on the left of a double column was 3x the noise fom pixels on the right
- Despite looking like noise, the counters were not saturating → the front-end was oscillating

Cross-talk feedback

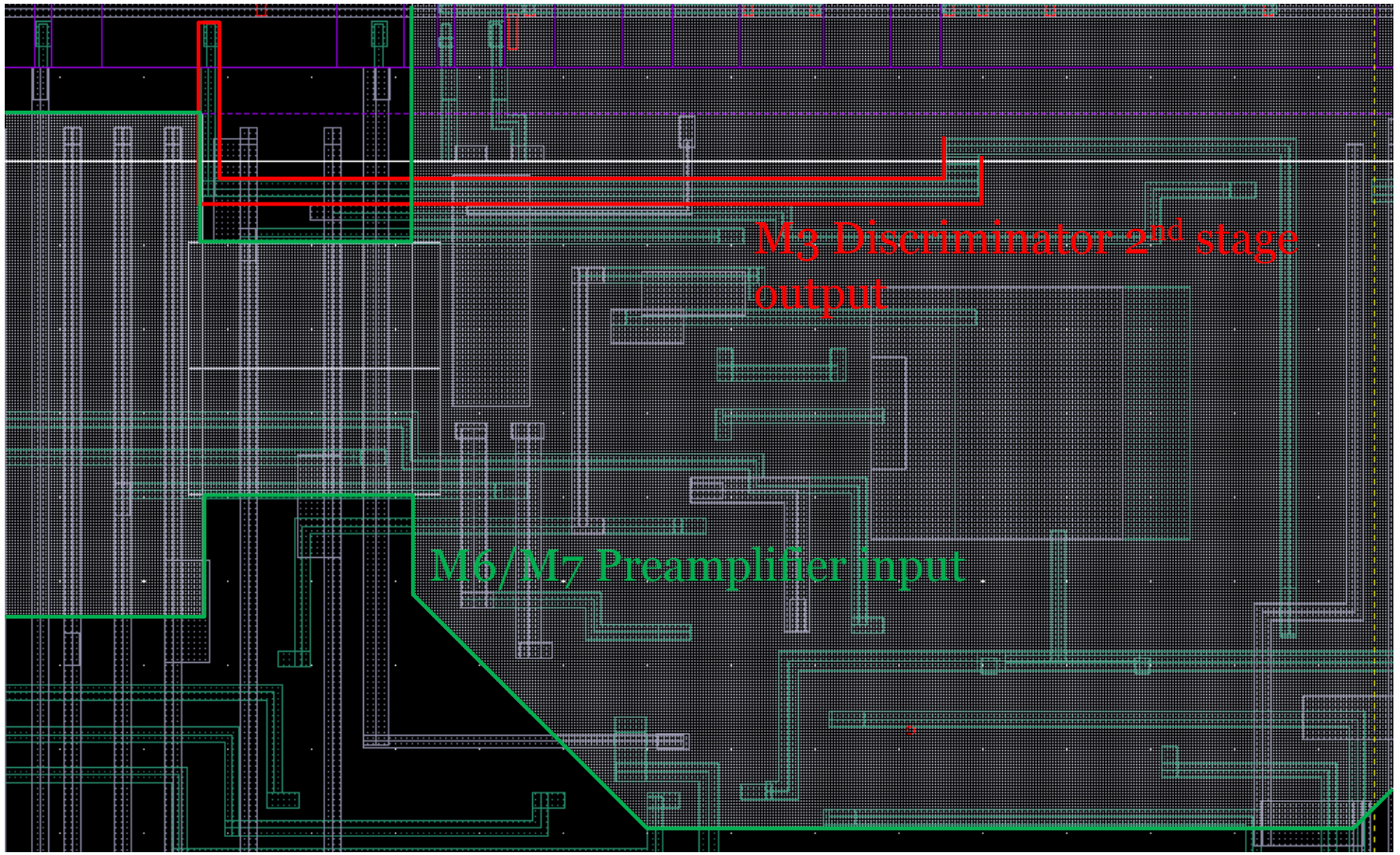


- Due to an error in the physical layout of the cell, the output injects charge which feeds back into the input

Physical view (left pixel)

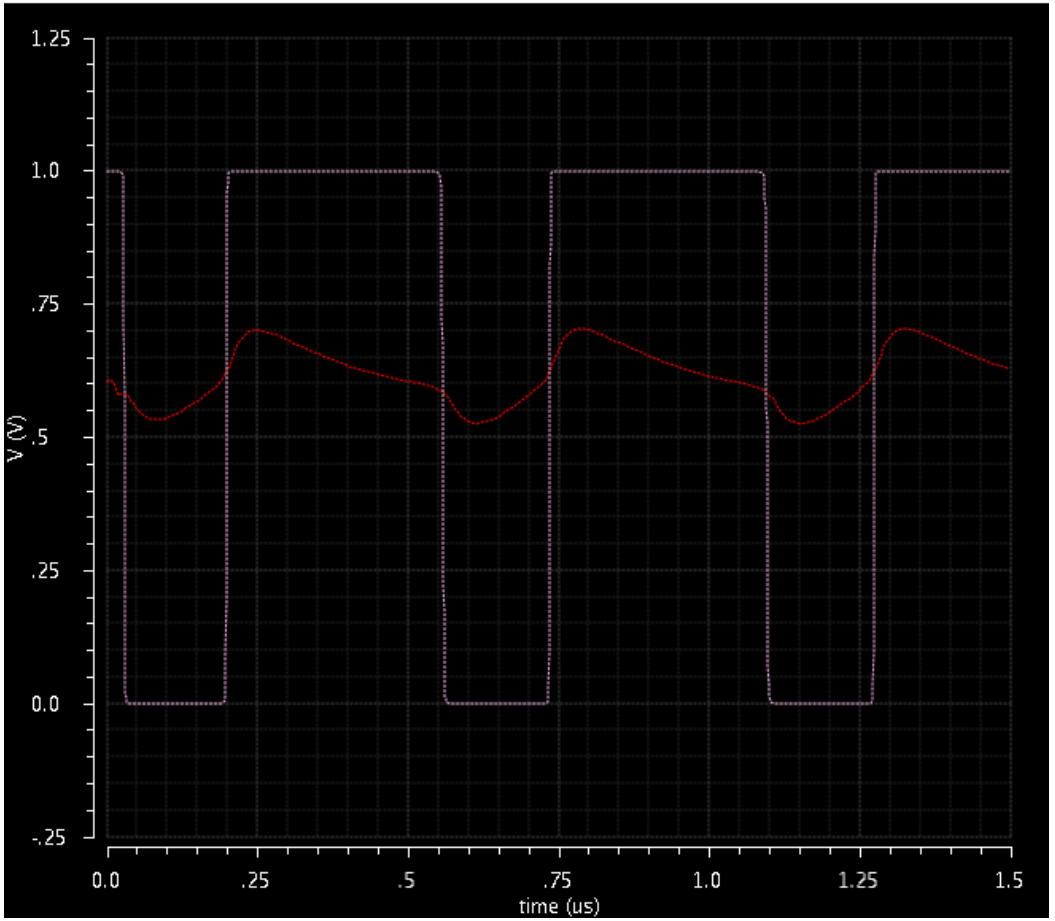


Physical view (right pixel)



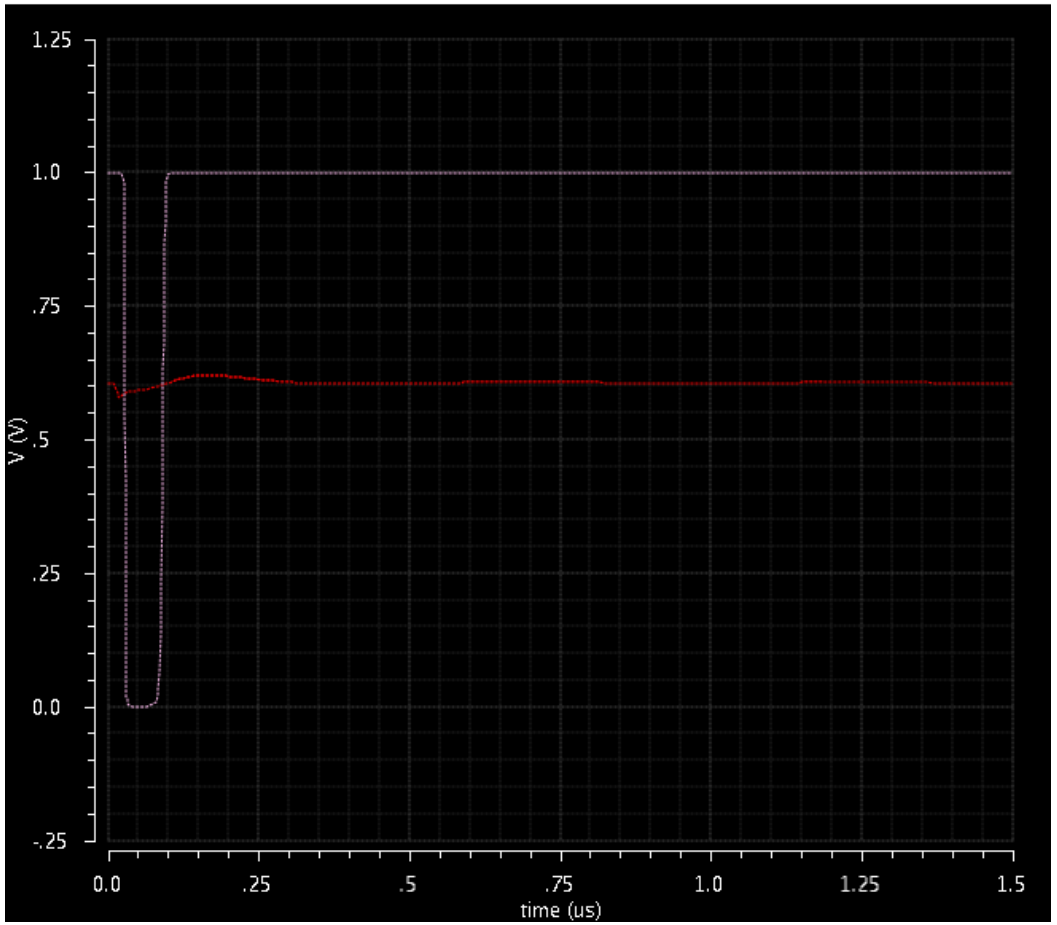
Simulated effect

- In holes collection polarity, if the threshold is close to the baseline, the injection can produce a pulse in the opposite direction, making the front-end oscillate
- The frequency of the oscillation is tied to the I_{krum} value, but otherwise the effect is mostly independent from the working conditions of the chip.



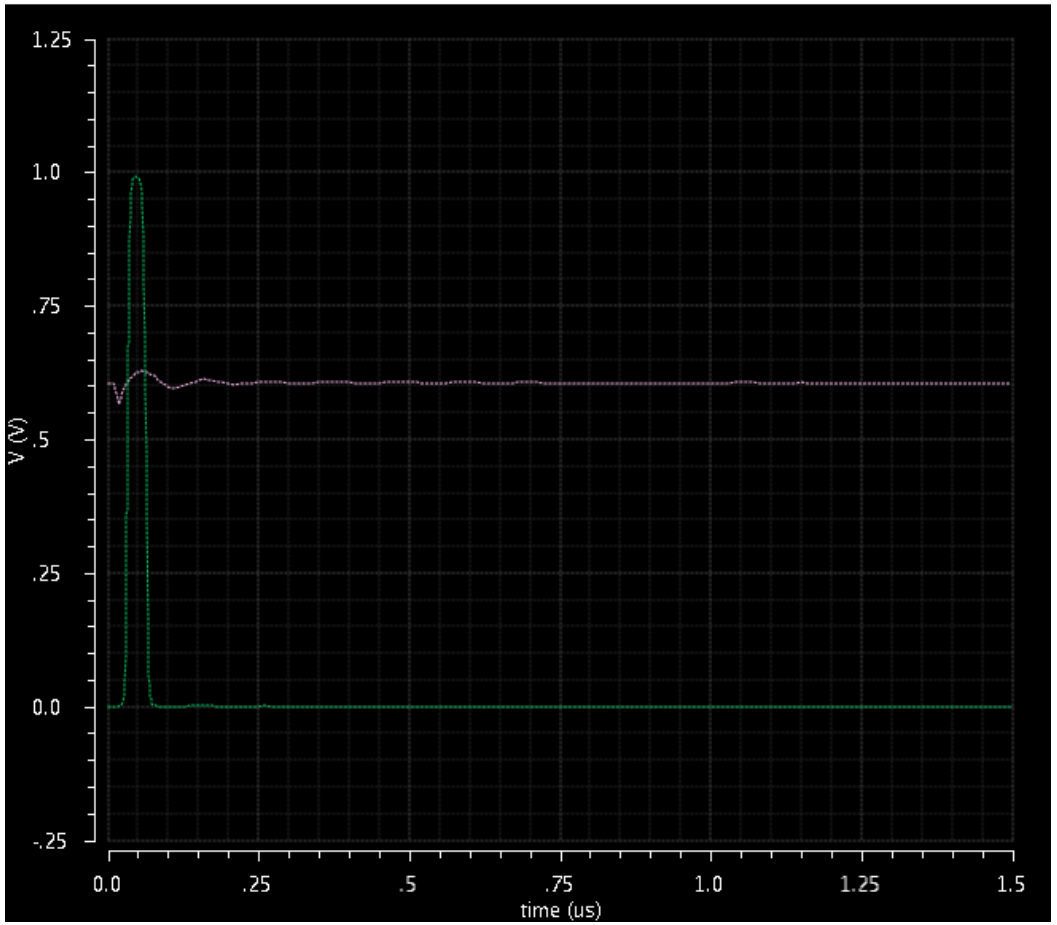
Simulated effect (different pixels)

- For pixels in the right side of double columns, the injection is much smaller, so it increases the measured noise, but it doesn't cause the front-end to oscillate



Simulated effect (other polarity)

- For the other polarity, the injection is subtracted from the input charge. It will cause a shift in the TOT measurement, but it doesn't cause the front-end to oscillate



Workarounds and long-term effects

- Unfortunately I don't think there is any valid workaround, as the effect is largely indipendent from the biasing conditions of the chip.
- The only solution is to set the threshold far away from the baseline (>1500 e^-) so that the front-end can't start oscillating. If the threshold is high enough, the performances of the measurement shouldn't be affected by the issue, apart for a small offset in the TOT count.
- More unfortunately, the HVCMOS sensors we have access to operate mostly in the worst polarity

- The issue is not related to the architecture of the chip or the technology used. It's a layout mistake which can be solved with better routing and shielding.

Other issues discovered

- The cause of the melted wirebonds that damaged a couple of assemblies has been discovered. It was due to an incorrect timing in the reset sequence of the powering circuit
- An issue with a few pixels presenting “phantom hits” (with a TOT of zero and TOA of one) only in TOA mode is being investigated and it’s still unclear whether it’s caused by the chip or the readout system. In any case this problem doesn’t affect the measurement results as those hits can be safely ignored (and they don’t appear in event counting mode)