PLAS: A 32-CHANNEL, DEAD TIME-LESS ANALOG MEMORY ASIC FOR THE TRACE DETECTOR

R. J. Aliaga1*, V. Herrero2, S. Capra3, J. A. Dueñas4, A. Pullia4, A. Gadea1, D. Mengoni5

*Contact: raalva@ific.uv.es

PLAS is a low power, compact ASIC for the TRACE front-end that carries out:
- zero suppression
- local triggering
- timestamping
- pulse sampling
- serialization

Typical analog memory circuit: one SCA per channel.
- Capacitors sequentially connected to bus to write analog voltage values until stopped by trigger.
- Read out later one by one and digitized externally.
- High write frequency, low read frequency.

Problem: Cannot be rewritten until read out. Limited by read frequency. Very long dead time.

Existing solutions: Partial readout, channel replication.

New solution: Split the memory into two sequential SCA stages.
- Stage 1: One short SCA per channel for pre-trigger samples.
- Stage 2: A few slots containing one long SCA for post-trigger samples and one short SCA to store a copy of Stage 1.

Advantages: no deadline, reduced number of cells
Disadvantages: more complex calibration, noisier pre-trigger

PLAS prototype specifications

- Technology: 0.18μm CMOS
- Die size: 3.5 × 3.9 mm²
- Input channels: 32
- Queue slots: 8
- Memory depth: 224 per slot (32 pre-trigger + 192 post-trigger)
- Write frequency: 200 MHz (100 MHz DDR)
- Read frequency: 50 MHz
- Power supply: 1.8 V
- Internal range: 0.3 V to 1.5 V

Simulated performance

- Input bandwidth: 100 MHz
- Output noise: 11.9 ENOB
- Power consumption: 10 mW/channel

PLAS (PipeLined Asymmetric SCA)

PRINCIPLE OF OPERATION

- The 1st stage is sampling like a circular buffer.
- On trigger, the channel is locked.
- Capture continues at a free slot in the 2nd stage.
- During capture, 1st stage samples are copied to a buffer in the 2nd stage.
- After capture, the 1st stage is ready again. No deadline.
- The captured pulse samples are read out later at a slower rate.

Readout is organized in frames with analog samples and digital data (timestamp and internal tracking).

Input channel features

- Input polarity: Configurable
- Input range: Configurable (external resistor)
- Trigger mode: Programmable
- Trigger threshold: Programmable, 2 per channel