EP R&D Day – CERN – MAY, 2024

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on behalf of the MALTA collaboration
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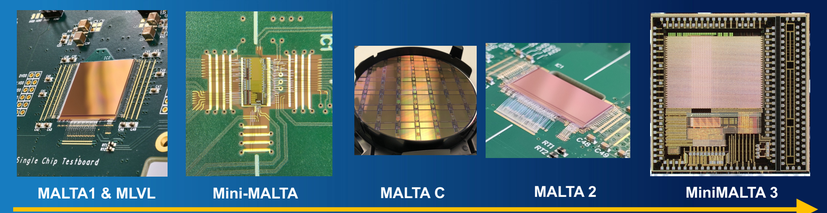
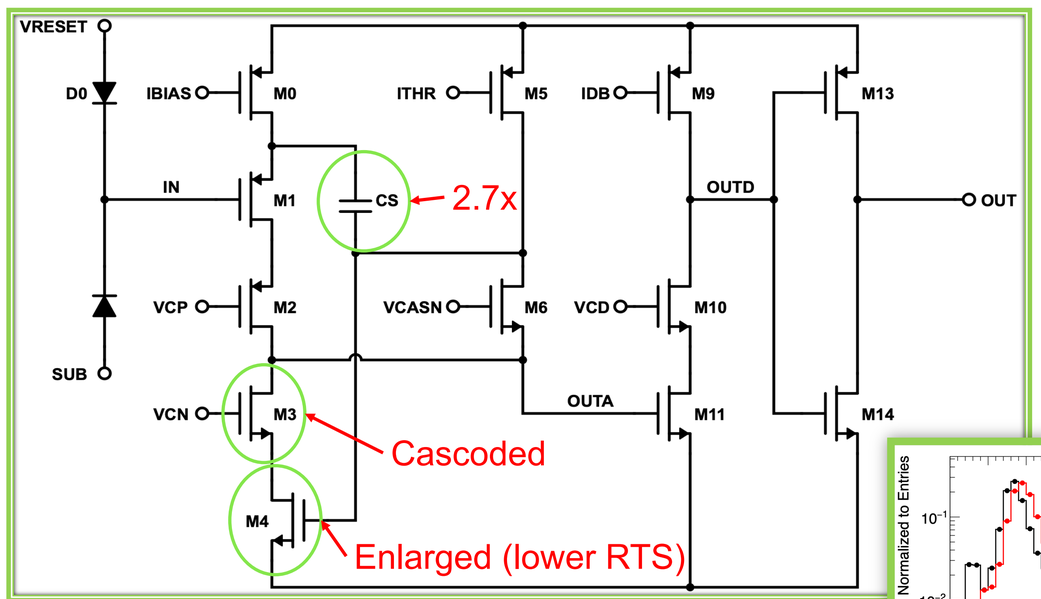


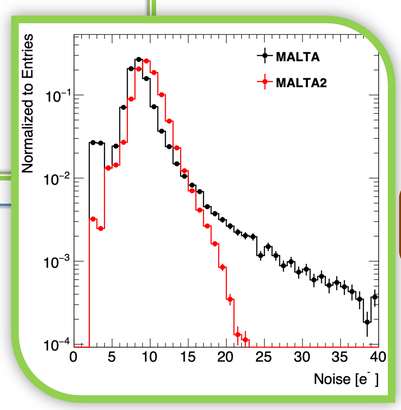
MiniMALTA3 DMAPS

The MiniMALTA3 DMAPS considered a small prototype of MALTA3, utilizing Tower 180 nm technology with process modifications and front-end changes, aims to enhance charge collection efficiency to 3E15. It incorporates upgrades to synchronization memory, enabling clock speeds of up to 1.28 GHz for improved timing resolution, alongside enhancements to the data output protocol.

Front-end Improvements from MALTA2

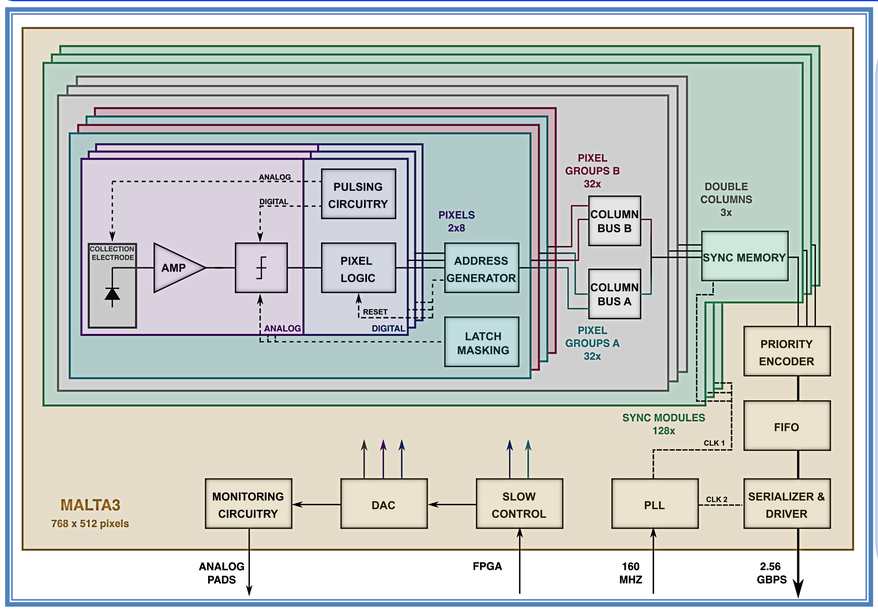
- Cascoded front-end introduces a new transistor in series with the input node.
  - Increases the gain of the front-end
  - **Reducing the threshold** reach
- Standard front-end with larger size feedback NMOS transistor (L) have **lower RTS**





Noise distributions of irradiated MALTA and MALTA2 samples

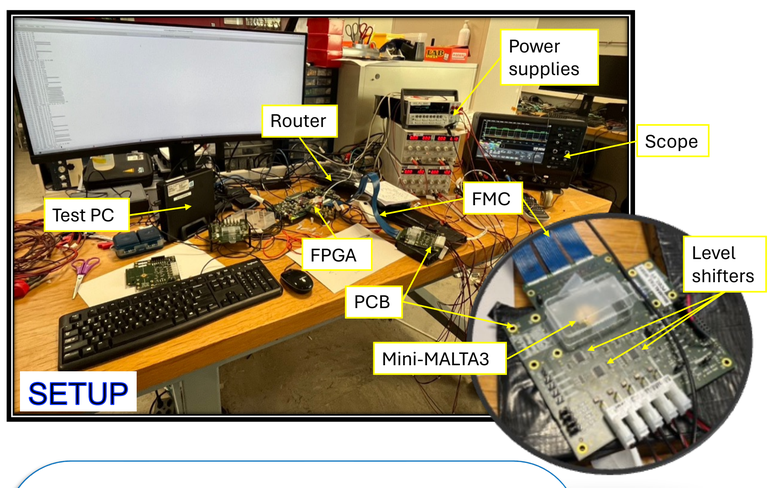
MiniMALTA3 Architecture

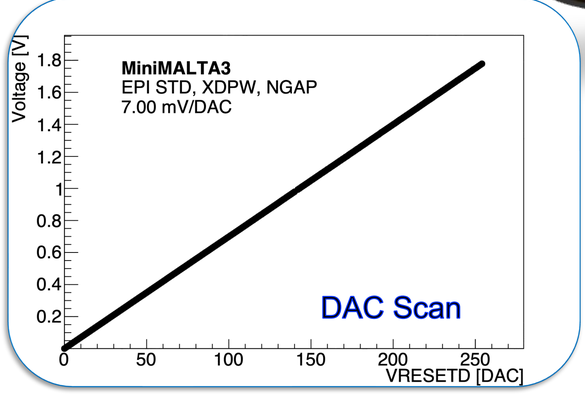


- **5x4** mm2 demonstrator
- 48x64 matrix size
- 36.4 um2 pixel size
- No clock over the matrix
- Synchronization memory with **0.78 ns** time resolution
- After hit detection, a reference pulse is generated

- Fast clock generation with PLL from 80 MHz input to **1.28 GHz** output
- Slow control implemented in I2C and **shift register protocols**
- Reset and pulsing implemented via fast command input at 320 MHz
- Output data using Aurora 66/64 bits scrambled
- **Data serialization** at 1.28 GHz DDR (2.56 GHz)
- LAPA is a pseudo-LVDS used for receiver and transmitter

Results

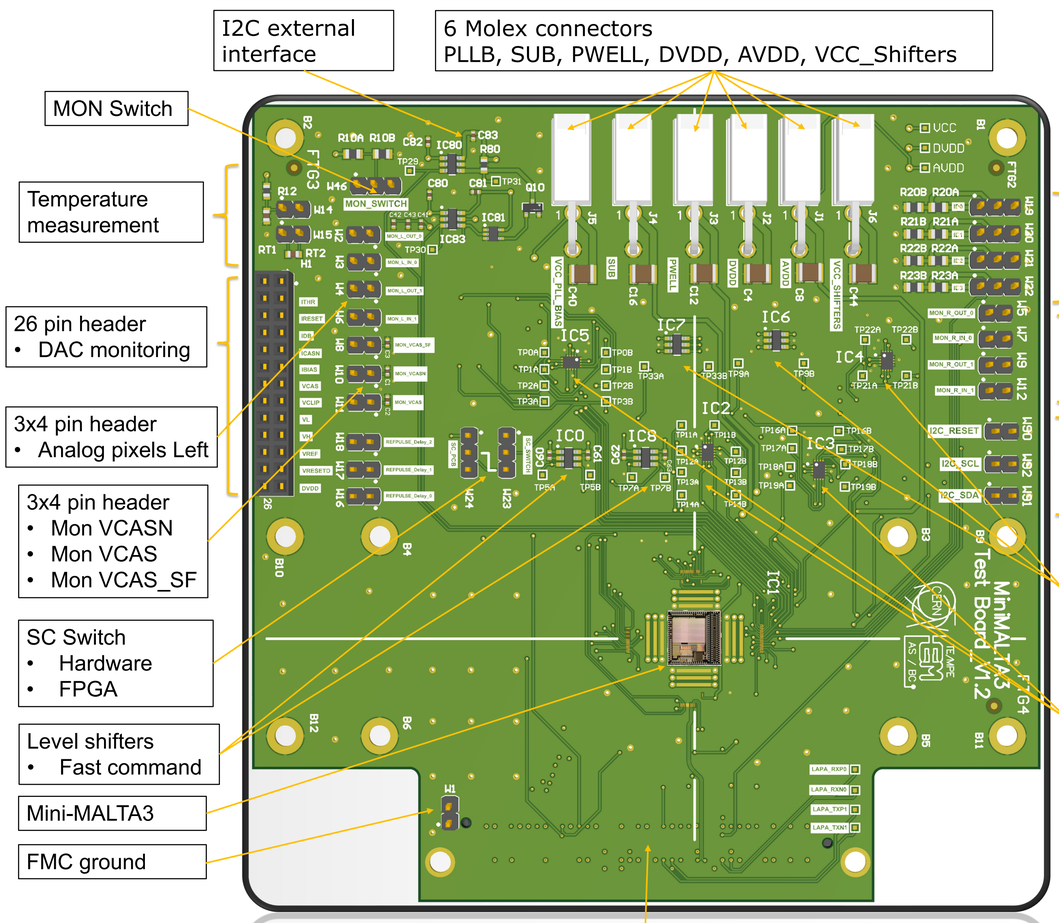




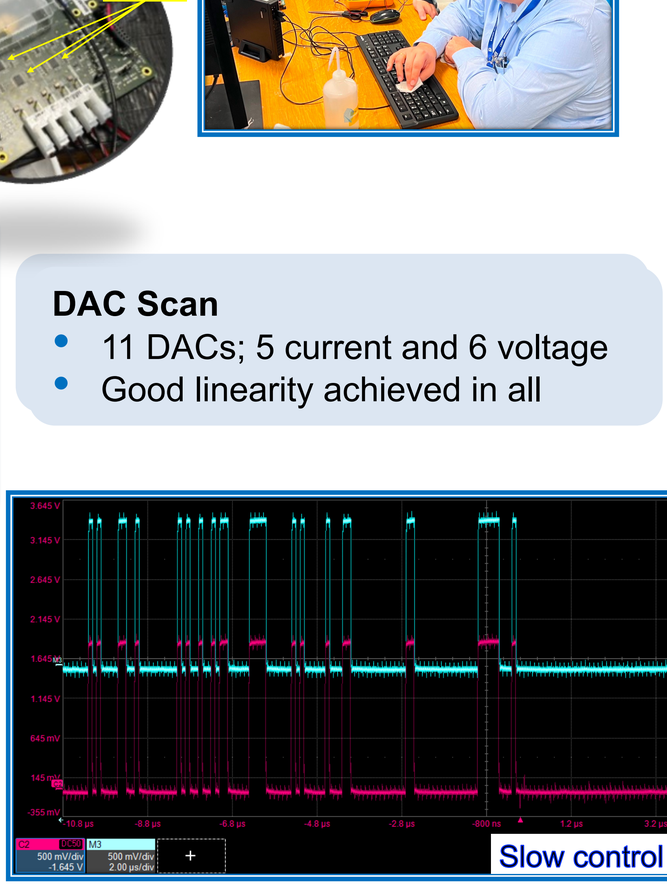
DAC Scan
- 11 DACs; 5 current and 6 voltage
- Good linearity achieved in all

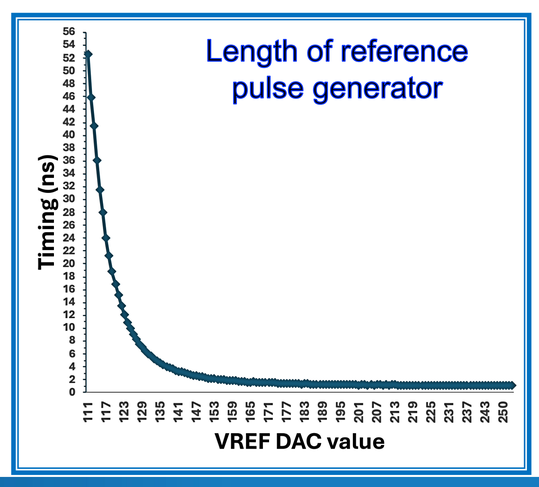
Mini Malta 3 PCB

- MiniMALTA3 PCB fabrication details:
  - Layers: 8
  - Surface Finish: ENIG
  - Thickness: 1.5 mm
  - Material: FR4 High Tg, PCL 370HR
  - Impedance Control: yes, for high-speed differential signals
- Wirebonding: used for PCB-chip communication
- Test Points: 32 added for CMOS signals



Slow Control
- Can be operated with shift register (436 bits)





Length of reference pulse generator
- Timing precision of ~1ns achieved

Next Steps
- Propose this architecture for DRD3
- Test-Beam measurements 2024
- Radiation measurements
- Design of MALTA3 prototype