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MC-PAD Project (**P11**)- Front End Electronics

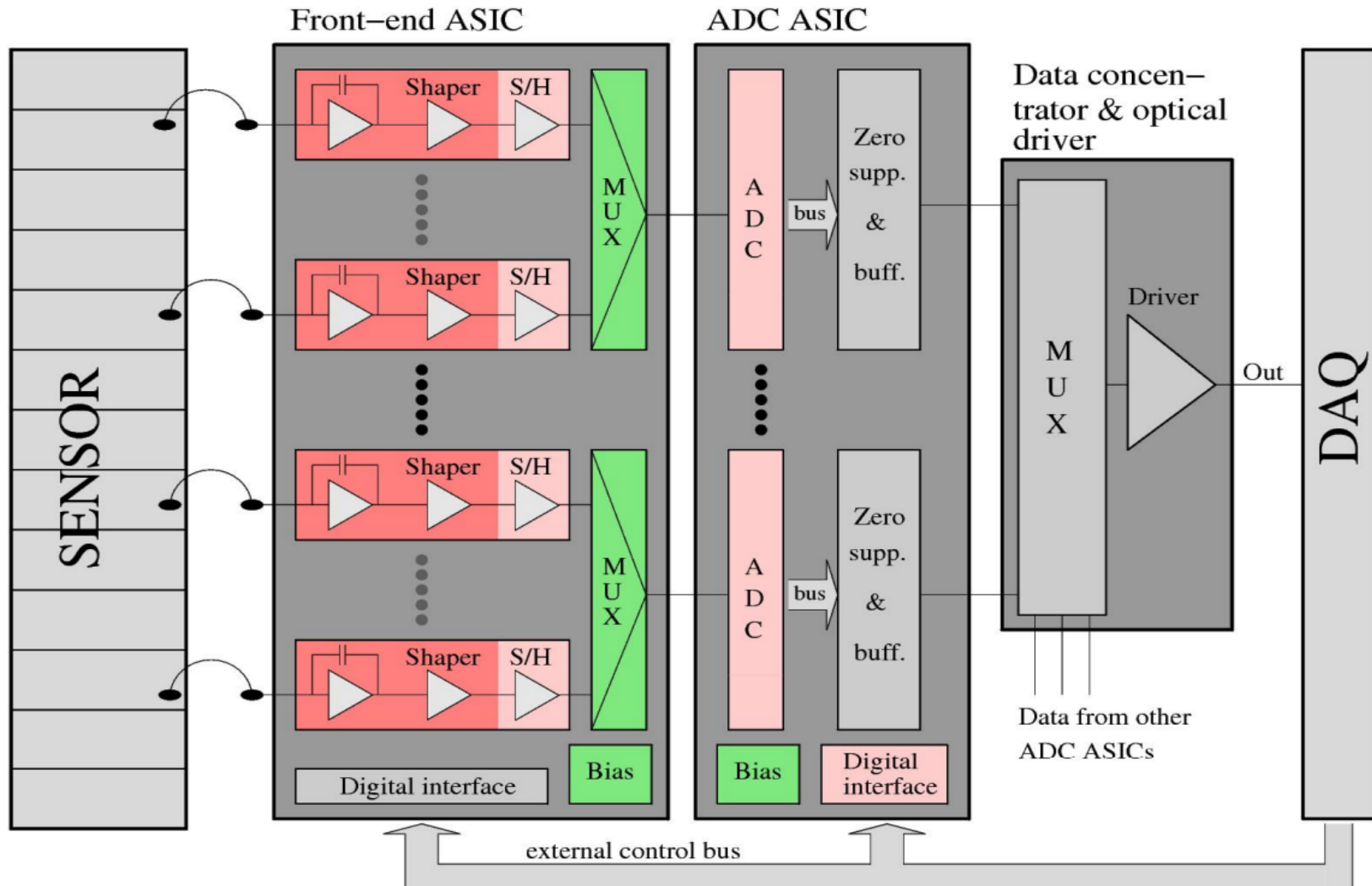
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Contents



- ◆ LumiCal Readout System
- ◆ My work
 - ADC Testing and Measurement
 - Command decoder- Multi-channel ADC
 - I²C Interface for readout ASICs
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Readout System



ADC Measurements



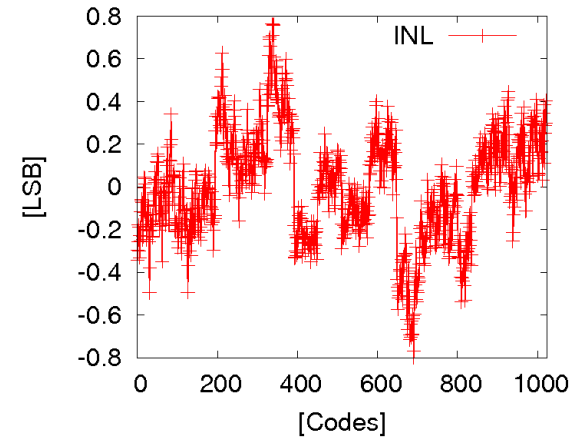
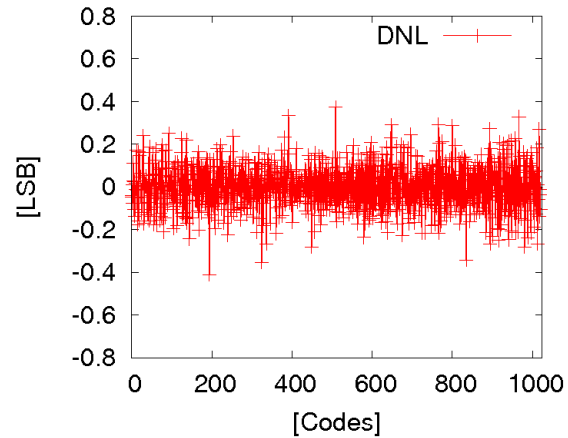
Purpose ?

Functionality, Verification and Characterization.

Measurements

- Static Parameters
- Dynamic Parameters

ADC Static Parameters

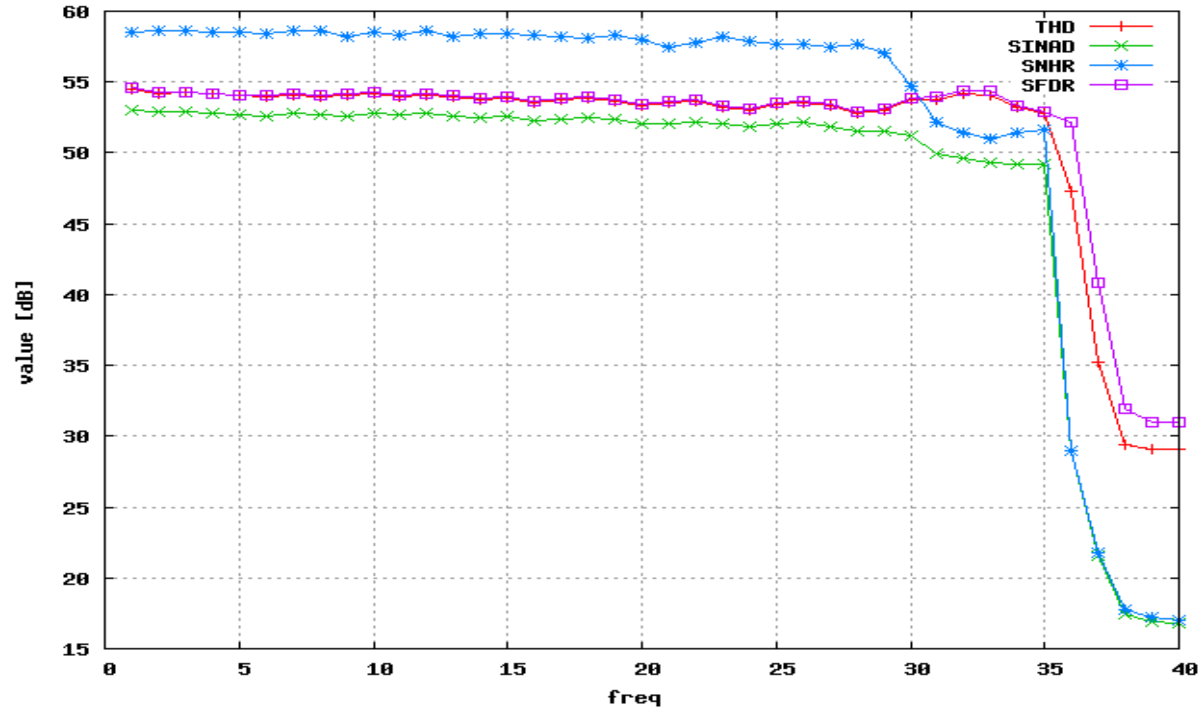


The ADC is ***functional***.

The Static DNL is found to be $0.5 < \mathbf{DNL} < 0.5$

and static INL $-1 < \mathbf{INL} < 1$

ADC Dynamic Parameters



Signal to noise ratio was found to be at **58.3 dB** up to 25 MHz.

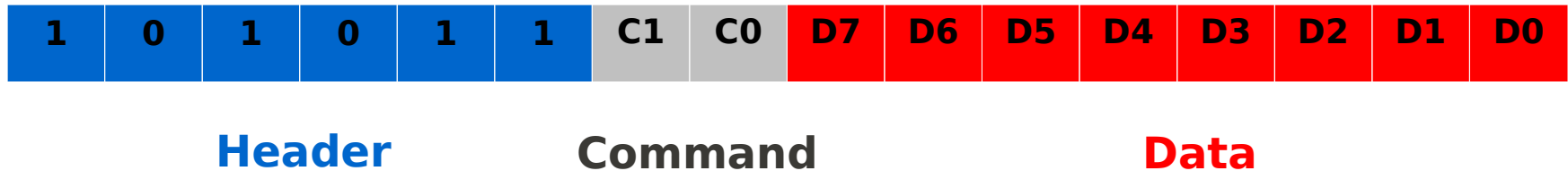
ENOB > 9.3 bits

The ADC measurements are complete and ready to be implemented in the readout system.

Command Decoder



Generates command signal based on the serial word. The serial command protocol is shown here.



The configuration command will be used to operate the ADC in different modes.

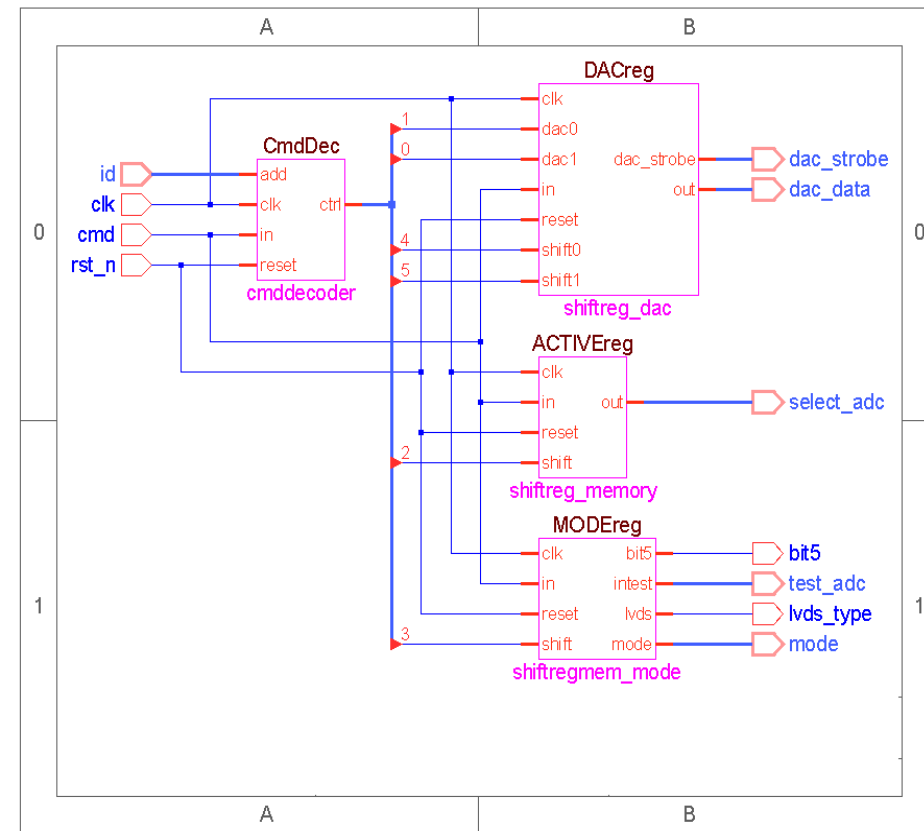
Command Decoder



Design Implementation

- *RTL module & simulation testbenches* written in Verilog HDL.
- Post synthesis, *gate level simulation* were successful.
- *Code coverage analysis* results were >97%

Schematic: Top level



I²C Interface



Our aim is to implement an I²C interface for slow controls on the readout ASICs.

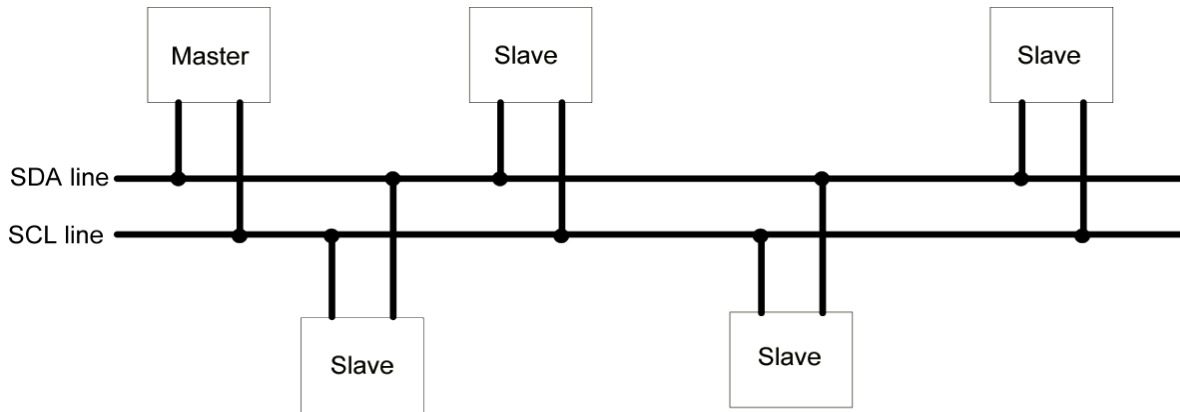
I²C basics:

- Two-wired bus.
- Slow to medium speed communication.
- Data transfers: serial, 8bit oriented, bi-directional.
- Master can operate as transmitter/receiver.

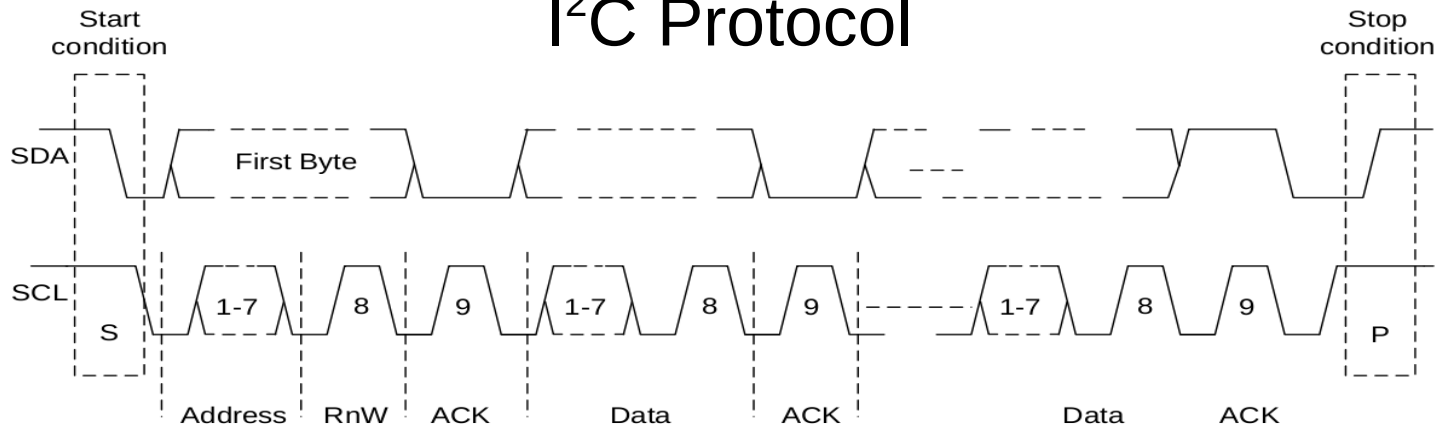
I²C Protocol



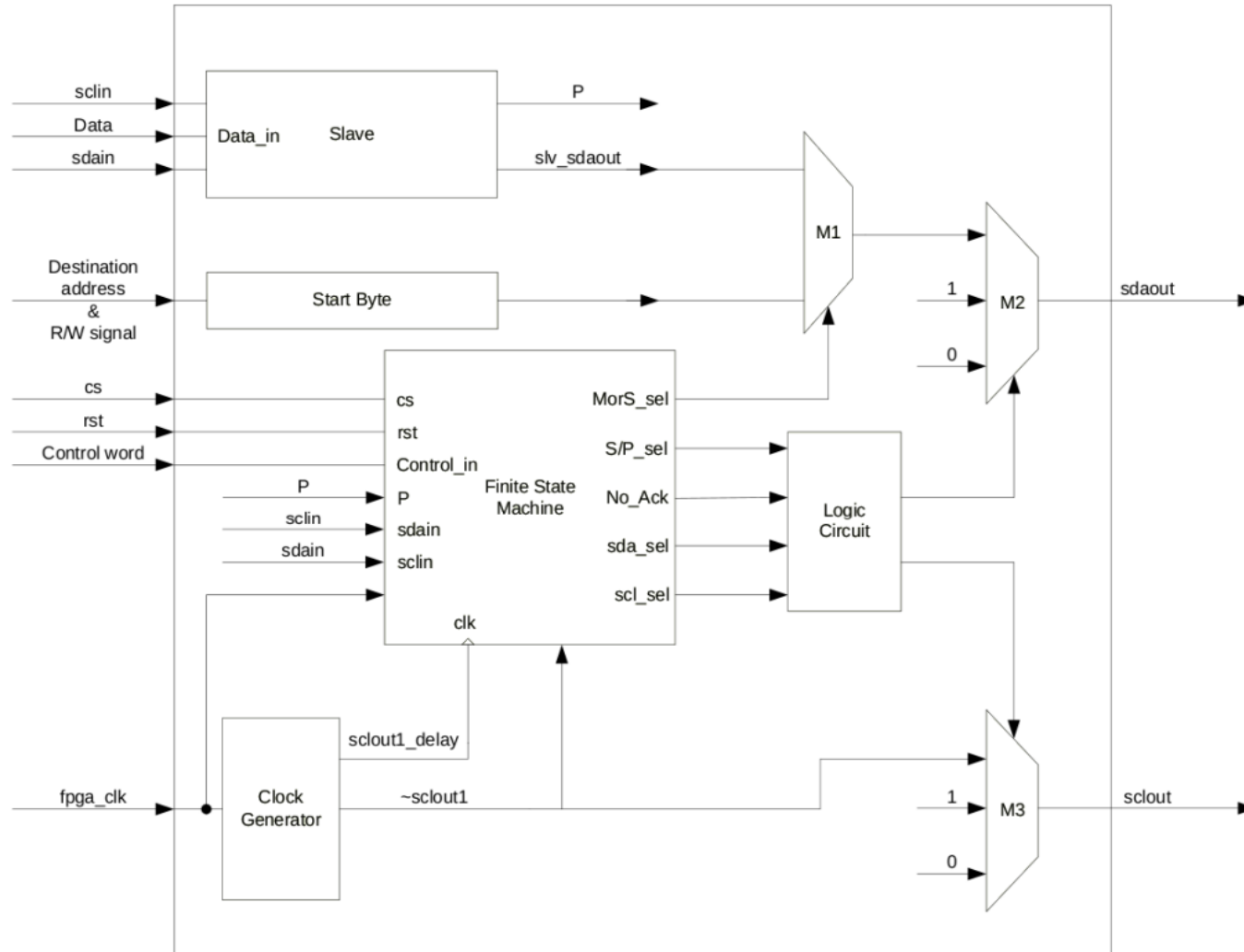
I²C Configuration



I²C Protocol



I²C Implementation



Activities



Training

IDES A *Advanced Analog Implementation Flow* Jun 2009 at AGH-UST.

MC-PAD Network Training

- *Readout Electronics* Sep 2009 at AGH-UST.
- *Detector Simulation and Data Analysis* Jan 2010 at DESY, Hamburg.
- *Processing and Radiation Hardness of Solid State Detectors* Sep 2010, at JSI, Ljubljana.

Publications

- Readout electronics for LumiCal detector, EUDET Report 2009.
- Forward Instrumentation for ILC Detectors, JINST(Submitted).
- A power scalable 10-bit pipeline ADC for Luminosity Detector at ILC.(ieee., under review)



Thanks MC-PAD & FCAL