Development of Large Area Photo-Detectors: 
Electronics and Transmission Line Readout

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Abstract

Fast Micro-Channel Plate (MCP) photomultipliers with a transmission line readout can provide psec range timing measurements when used with GHz bandwidth electronics. We are developing a microstrip transmission line readout array on the base plate of the large-area MCP detector. The signal strips will be read out on both sides of the detector and the time-of-arrival difference gives the location of the event along the stripline. In order to minimize the time spread of the detector, the signal should be analyzed as close as possible to the readout striplines. For this, we developed a 4-channel sampling and digitizing ASIC using the IBM 130nm 8RF CMOS process. The ASIC design, the transmission line readout and the integration of the two are presented.

Prototype Sampling ASIC

- 4 channel sampling chip designed using IBM 130nm CMOS process
- Analog signal sampled on array of switched capacitors. Memory depth of 256 samples per channel.

Block Diagram

- shows 1 analog input

Modes of Operation

- Write
  - Timing generator runs continuously, outputs 256 phases, 100 ps spaced
  - Each phase controls write switch to sampling capacitors

- A/D Conversion
  - Wilk. conversion using 2 µs voltage ramp
  - 256 conversions done in parallel

- Read
  - Serial readout of data by ‘passing token’

Readout-ASIC Integration

Initial Test Setup

Specifications

- Sampling rate: 10GS/s
- Analog Bandwidth: 2GHz
- Dynamic range: 0.1V
- Sampling window: adjustable 500ps-2ns
- Sampling jitter: 10ps
- Maximum latency: 1µs
- Crosstalk: 1%
- DC input impedance: 500 internal
- Conversion clock: Adjustable 1-2 GHz internal ring oscillator. Minimum conversion time 2ns.
- Read clock: 40MHz. Readout time (4-channel) 4 x 256 x 2µs x 256µs
- Power: 40mW/channel
- Power supply: 1.2V
- Process: IBM 8RF-EDM (130nm CMOS)

Chip Layout

Due back from foundry Oct. 19

The proposed anode microstrip array (32 strips) is shown on the right. The base plate is 8 x 8 in² and the copper strips are 3.75 mm wide. The microstrip principle presented on the left – the strip is optimized for 50 Ω impedance.