Application Of Multiple Use SiPM Integrated Circuit (eMUSIC) For Readout Based Time-Of-Flight Detectors

Design Overview

- Three operation modes.
  - Pixel summing in differential mode.
  - Individual Binary Single Ended.
  - Individual analog SE channels.
- Fast OR trigger.
- Tunable Pole Zero Cancellation.
- Slow Control SPI.
- 0.35µm SiGe BICMOS.
- High speed applications such as GCT, Particle Physics detectors.

Block Diagram

- eMUSIC ASIC is used as a beam loss monitor in order to capture variations in rate during the operation of the accelerator in ALBA.
- Silicon photomultipliers (SiPM) attached to each end of scintillator fiber are used to detect beam losses.
- A dedicated board which integrates the eMUSIC ASIC and 40ps RMS FPGA-based time-digital-converters (TDC) to determine the arrival time of each photon.

Beam Loss Monitor – eMUSIC Board for the ALBA Experiment

- eMUSIC captures the difference in rate by counting the amount of events (photon counting) detected at each end of the fiber with the single ended binary output.
- Initial testing showed 20cm spacing Resolution using a 4m scintillation Fiber.

Time of Flight Timing Detector–eMUSIC Mini Board

- General purpose evaluation board based on eMUSIC chip, an 8-channel readout ASIC for SiPM arrays.

Features:

- Dimensions: 5x5cm²
- Microcontroller to configure the ASIC and to integrate it into the data acquisition system.
- Analog or Binary discriminated.
- Summation Single/Differential and High or Low gain.

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SHIP Experiment at CERN SPS (Super Proton Synchrotron) Timing detector to search for hidden particles.
- Plastic scintillator bar with a size 168 cm x 6 cm x 1 cm.
- Array of 8 Hamamatsu S13360-6050PE SiPMs.
- 100 ps time resolution using the summation output and a Digital CFD in the acquisition system (Wavecatcher).