Abstract

The WaveDAQ data acquisition system has been developed at PSI, Switzerland, in collaboration with INFN Pisa in the past ten years. It features integrated data acquisition up to 5 GSPS/12 bits of resolution using the DRS4 chip, combined with sophisticated triggering capabilities using 80 MHz/12 bits ADCs. The DAQ boards of this system have integrated bias voltage generation for SiPMs up to 240V, shaping, pre-amplification and scalers. Each board with 16 channels can be either read out directly via onboard Gigabit Ethernet, or in a custom crate using Gigabit serial links.

A 3 HE custom crate houses up to 256 channels. It contains power, clock distribution, global triggering and data readout with 10 GBit Ethernet, allowing timing measurements down to 10 ps resolution. The overall system for the MEG experiment has been successfully installed and operated with ~9000 channels in 37 crates.

WaveDREAM Board

The WaveDREAM (DRS4 based READout Module) contains 16 analog channels, two DRS4 switched capacitor array chips and their readout ADCs. A Spartan6 FPGA with a MicroBlaze CPU manages all functions of the board. 10-layer PCB with >2000 parts.

Lessons learned during last ten years

- Mixed signal boards are quite tricky but can be done
  - FPGA / GBit links \(\leftrightarrow\) <50 µV noise at inputs
  - DC-DC converters have to be "hand-picked"
  - Switching PS works well in crate, but needs good shielding
  - Keep all clocks in phase, so clock noise can be calibrated
- Custom crate system design went quite well
  - Concentrate on what is really needed
  - Using (softcore) CPU on boards is essential
  - Intelligent crate controller crucial for monitoring, rebooting individual slots, firmware upgrades
- WaveDAQ system finally works well for MEG II experiment as the only option, now also used in FOOT and LoLX experiments
- WaveDAQ is an interesting option for many applications: Beam scanners, calorimeters, drift-chambers, …