DAQ and visualization software for GEM detectors
GEM detectors DAQ using TI DDC series current/charge ADC

- DDC series IC's are based on switching capacitor integrators,
- There are two integrators for each measuring channel - they are working alternately,
- Sigma-delta ADC is used inside IC's,
- External Vref is needed.
GEM detector V1.1

- Designed and validated,
- A few detectors are already delivered to clients,
- Channels: 128 x 128 strips,
- For 10x10 cm detector kit,
- Sampling rate of 6,25 kHz,
- ADC resolution 20-bit,
- Minimal ADC range – 6,25 pC,
- 100 Mbit Ethernet communication,
- Connects directly onto detector readout plate,
- Noise level: about 1 fC peak-to-peak disconnected from strip readout,
- With strip readout connected noise increases 3 Times,
GEM detector V1.1

- Protective resistors matrix
- Spartan-3 FPGA
- OLED display - displays IP config, detector status etc.
- Bias circuit
- Voltage stabilization
- Power supply connectors
- 100 Mbit Ethernet module
- DDC charge converters protected by shielding plates
- Charge analog inputs

GEM detector V2.0

- Design is based on experiences gathered from DAQ V1.1 detector project,
- Sampling rate is increased from 6.25 kHz to 17 kHz
- As the new DAQ is much faster, we can use higher count-rate X-ray source,
- ADC resolution is also improved from 20-bit to 24-bit,
- Minimal ADC range - 6.25 pC,
- 100Mbit Ethernet communication,
- 100Mbit communication is too slow for huge amount of data from new DAQ 😞,
- We introduced digital triggering and data processing inside FPGA,
- To measure noise performance and to validate the detector we have integrated digital phosphor function.

GEM detector V2.0

- External trigger connectors
- Power supply connectors
- OLED display - displays IP config, detector status etc.
- Artix-7 FPGA
- Bias circuit
- Voltage stabilization circuit
- DDC IC - 256ch charge converter
- Protective resistors matrix
- Charge analog inputs

GEM detectors measurement setup

- LV and HV power supply
- Lead covered enclosure
- Techtra GEM detector
- X-ray source
- Metal elements placed onto detector

Radiograph made with Cool-X Amptec miniature X-ray generator

RD51, 06 Dec. 2018
GEM detector data acquisition software

- Designed specially for our detector DAQ,
- Application performs data acquisition from the detector with 100Mbit Ethernet protocol,
- The integration time (sampling rate) and charge measurement range, can be set by a user,
- Charge bias injection to the DAQ inputs can be also defined and changed at any time,
- User can chose stored files types and number of measurements to execute,
- Data can be on-line visualized using chart option,

GEM detector data acquisition software - visualization

- Data from detector are transmitted in packages of 512 samples from each of 256 channels,
- We use candlestick plot to show average values and min-max values spread for each channels on one plot (based on 512 samples),
- On candlestick plot we can see on which channels we have detected events and how many such channels we have,
- On channel line plot we can see all of 512 samples from 1 chosen channel - something like oscilloscope.
GEM detector data visualization software

- Designed specially for our detector DAQ,
- Application performs DIGITAL TRIGGERing function on raw data,
- User can change triggering parameters to see the difference in results on the same raw data,
- Software automatically recognizes peaks correspond to events and reconstructs their position on the 2D map,
- User can see the image reconstruction progress on-live during data acquisition,

GEM detector data visualization software - energy spectra of events

- Energy spectra of detected events
- Visual indication of filter energy bandwidth - user can check which part of signal will be used in 2D reconstruction
- Chart with scales
- Image file save button
- Output data save button, txt file
- Energy range selector

GEM detector data visualization software - events distribution in time

Chart with scales
Image file save button
Output data save button, txt file
Time range selector

https://amptek.com

Measurement electronics designing and prototyping
Our Core GEM-team

RD51 collaboration

GEM detector, Techtra

TTA TECHTRA Sp. z o.o.
ul. Dunska 13
54-427 Wroclaw
Poland

phone: +48 71 798 58 85
www.techtra.pl
e-mail: techtra@techtra.pl