SIS18 Upgrade: The FAIR Compliant Renovation of the Data Acquisition System for Particle Detectors

R. Haseitl, H. Bräuning, T. Hoffmann, K. Lang, T. Milosic
GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt, Germany

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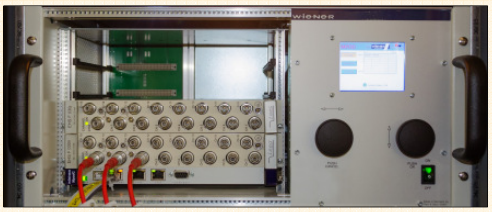
Abstract

In preparation for FAIR, several well-established beam instrumentation systems of the GSI heavy-ion synchrotron SIS18 and its connected high-energy beam transfer lines have to be modernised. This covers the upgrade of high voltage power supplies for particle detectors as well as data acquisition and readout electronics. Outdated custom-built hardware is being replaced by modern FMC based I/O hardware, new multi-channel high voltage power supplies and a new data acquisition system for the VME based scalers.

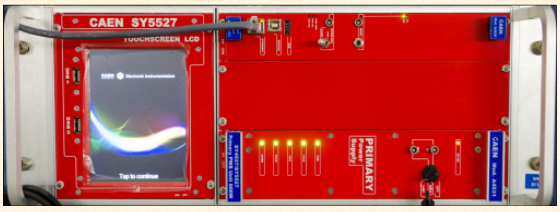
Abbreviations:

SIS18:	Schwerionensynchrotron	HV:	High Voltage
FMC:	FPGA Mezzanine Card	DAQ:	Data Acquisition System
SVEC:	Simple VME FMC Carrier	SEM:	Secondary Electron Monitor
RTM:	Rear Transition Module	IC:	Ionisarion chamber
IFC:	Current-to-Frequency Converter	Colli:	Collimator
FESA:	Front End Software Architecture	BLM:	Beam Loss Monitor
HEBT:	High Energy Beam Transfer	SC:	Plastic Scintillator

High Voltage (HV) Systems



Wiener MPOD mini crate with four HV module slots. The lower slots are populated with 16-channel HV modules made by iseg.



CAEN SY5527 HV crate with touchscreen. Six HV module slots are at the back of the crate.

Wiener crate / iseg modules

Wiener Crates with 4 slots (MPOD mini) and 10 slots (MPOD) are in operation at GSI. Crates and HV modules are controlled via Ethernet using Simple Network Management Protocol (SNMP) commands.
The HV modules are manufactured by iseg. The most common modules at GSI are 16-channels modules with positive or negative polarity, +/- 3000V, 3mA (e.g. EHS F 030n, EHS F 030p).

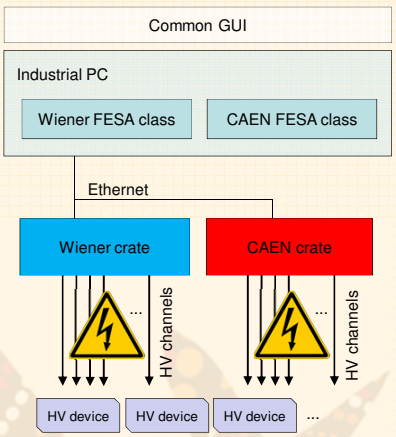
www.wiener-d.com / www.iseg-hv.de

CAEN system

At GSI, several SY5527 crates made by CAEN are installed with many different HV modules. The system is Ethernet-controlled by the CAEN HV Wrapper library available for Linux and Windows. Using the 'event mode' of the library, a custom application like a FESA class can subscribe to property changes of any crate, module or channel property. It avoids unnecessary polling and reduces the network load significantly.

www.caen.it

Software Setup



VME Digital IO (V-DIO)

Pictures: G. Otto, GSI

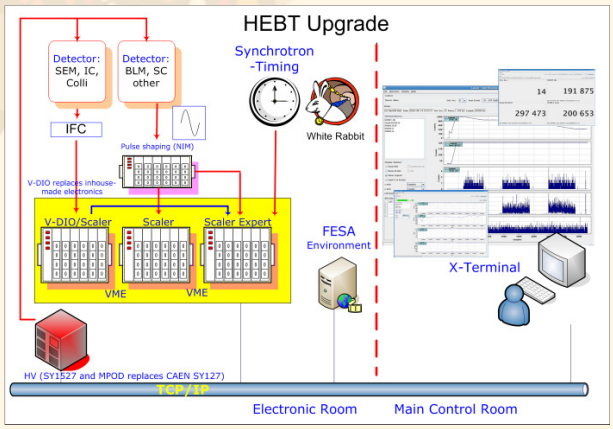
FMC module mounted on SVEC 6 HE VME card*

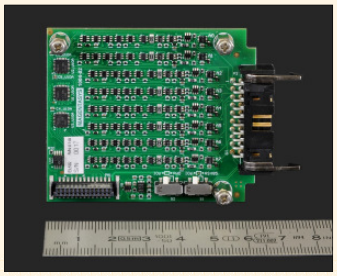
FMC specs:
- ten outputs
- two inputs
- indicator LEDs
- software-configurable
- commonly used to route signals from the rear mezzanines to external scalers

VME Rear Transition Module (RTM)
- 80mm version
- four mezzanine slots
- software-configurable

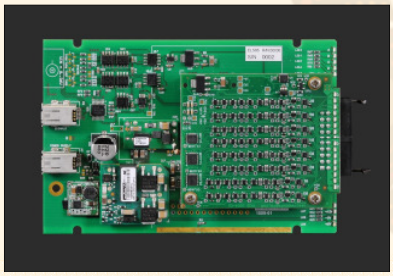
The new V-DIO system replaces outdated in-house built readout electronics for different particle detectors. It consists of multiple boards which have been manufactured by the company MagentaSys by GSI specifications.
www.magentasys.com

New Data Acquisition System





Mezzanine
- plugged into Rear Transition Module
- controls/acquires data from attached Current-to-Frequency converters (IFCs)
- 'general purpose mode' provides 16 I/Os at NIM or TTL level for arbitrary use
- additional special mezzanine for Deported IO functionality (no picture)



Deported Electronics Baseboard (optional)
- connected to the RTM via Cat 5 patch cables up to 350m long
- data transmission via I²C over RS485
- powered by special mezzanine on the RTM
- ensures short signal cables to the IFC hardware
- standard mezzanine attached on top

Particle detector data flow
- ion beam is measured by various detectors (SEM, IC, BLM, SC, ...)
- measurement values of SEMs, ICs and Collimators are converted from an electric current to countable pulses in IFCs
- IFCs are directly connected to the V-DIO mezzanine boards
- countable IFC signals are routed from the mezzanines to the front FMC outputs by the SVEC board
- measurement values of BLMs, SCs and other detectors have to be pulse shaped before getting counted
- all countable signals are fed into multiple 32-channel Struck 3820 scaler boards
- FESA classes read the counter values and provide them to the control system via the middleware
- various GUI applications subscribe to these values and present them to the operators

* Simple VME FMC Carrier (SVEC) in the Open Hardware Repository: http://www.ohwr.org/projects/svec

r.haseitl@gsi.de, h.braeuning@gsi.de, t.hoffmann@gsi.de, k.lang@gsi.de, t.milosic@gsi.de