Detector Control System for CBM-TOF

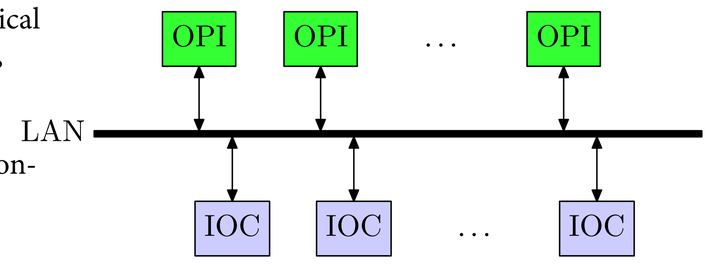
Abstract: For charged hadron identification, a high-performance time-of-flight (TOF) RPC wall is being built for the Compressed Baryonic Matter (CBM) experiment at FAIR. The Detector Control System(DCS) for CBM-TOF is designed based on the Experimental Physics and Industrial Control System(EPICS). Instruments including power supplies, power supply distributor, and gas control system are controlled and monitored in the mini-CBM(mCBM). For monitoring the environment of detector and status of front-end electronics, based on IPbus a slow control application is implemented.

TOF DCS Overview

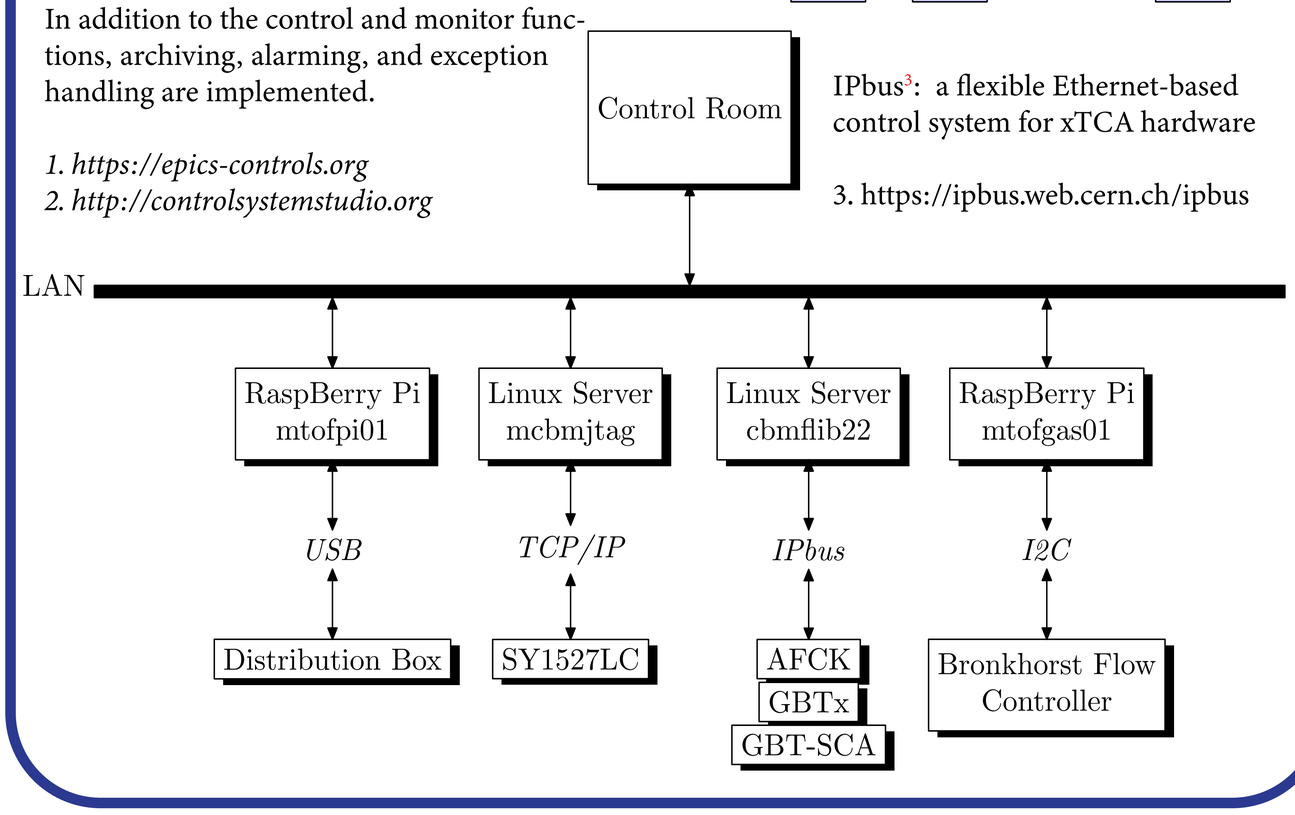
A typical EPICS[1] control system has the physical structure based on OPI(Operation Interface), IOC(Input Output Controller), and LAN.

The OPI of TOF DCS are created by CSS[2](Control System Studio).

In addition to the control and monitor functions, archiving, alarming, and exception handling are implemented.



IPbus[3]: a flexible Ethernet-based control system for xTCA hardware

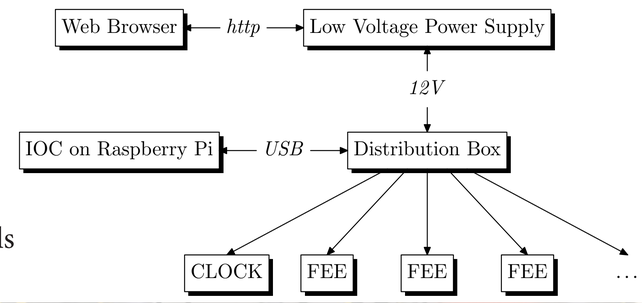


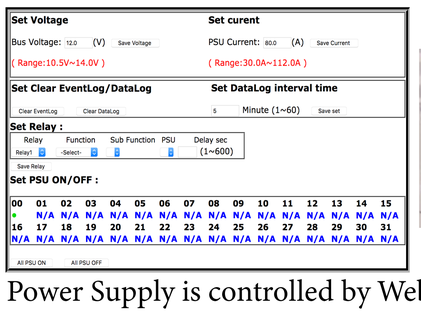
1. https://epics-controls.org
2. http://controlsystemstudio.org
3. https://ipbus.web.cern.ch/ipbus

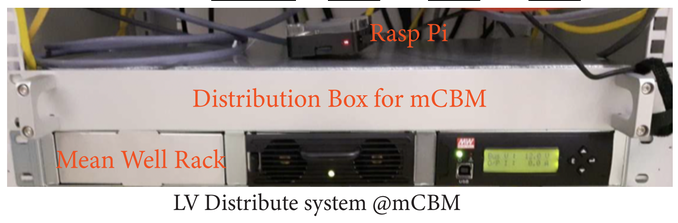
Low Voltage And Power Distribution

Low Voltage Power Supply:
- MeanWell RCP-2000-12
- MeanWell RKP-1UI- CMU1
- 12V, 112A Max

Distribution Box:
- Desiged by GSI
- Fan out 1 channel to 16 channels





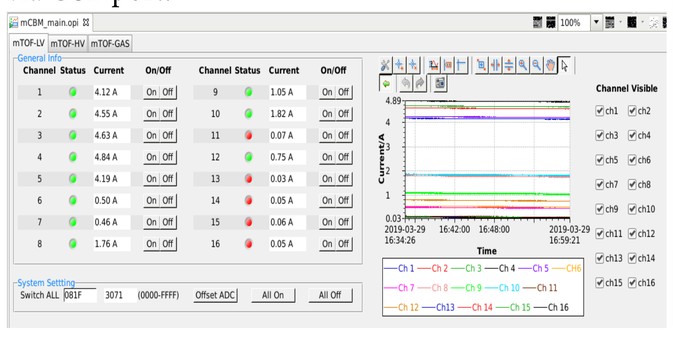


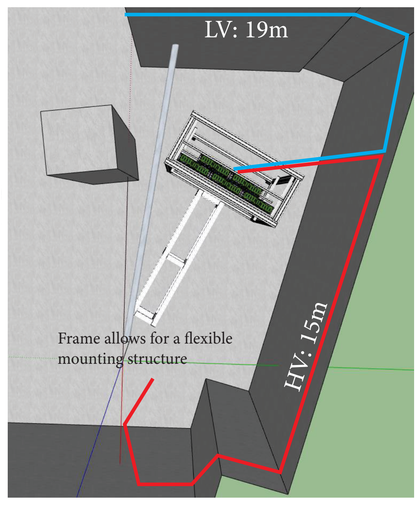
LV Distribute system @mCBM

Power Supply is controlled by Web Server.

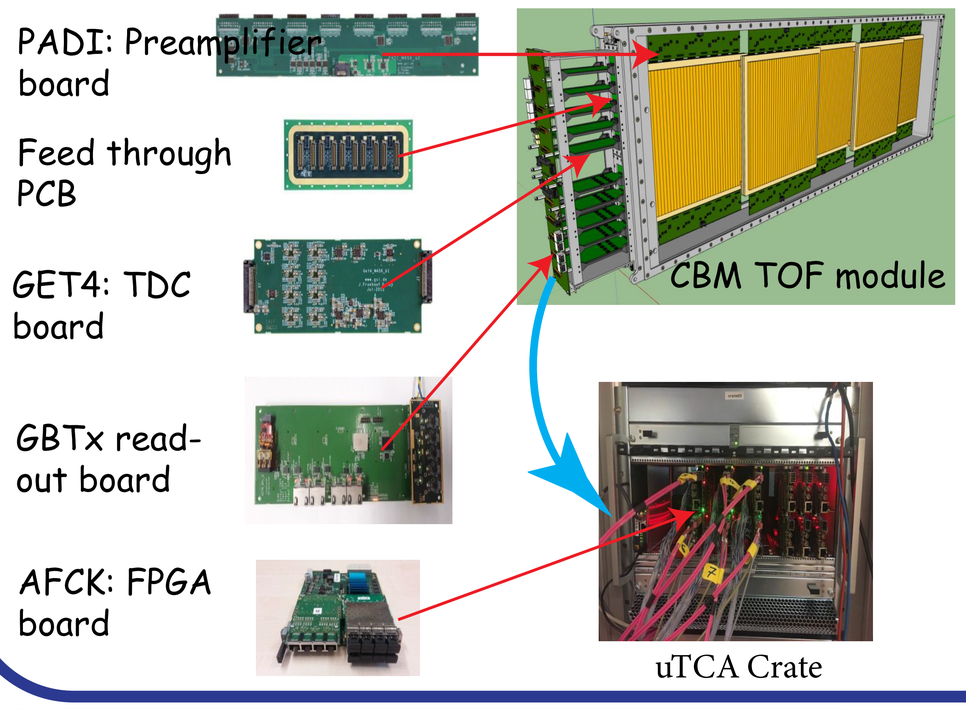
IOC runs on Raspberry Pi .

Distribution box is controlled by Raspberry Pi via USB port.





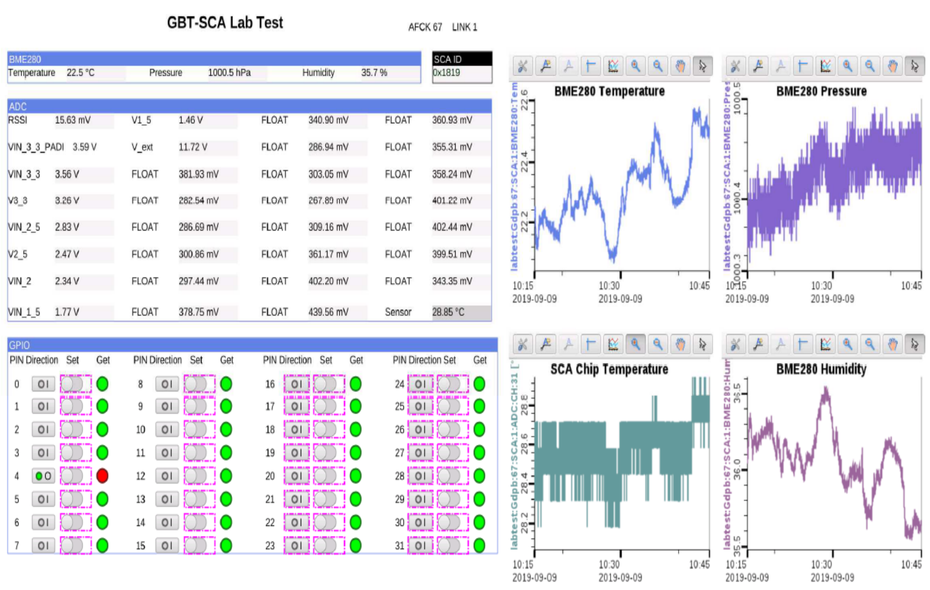
FEE and Detecotor Environment



GBT-SCA ports adopted:
- I2C -> BME280
- GPIO -> Clock source switch
- ADC -> FEE power status

Two sensors(BME280) are equipped on Feed Through PCB for monitoring temperature, pressure, and humidity. One is inside the detector, and the other is outside the detector.

The slow control data is transferred to PC through front-end electronics and read-out Firmware. And an Ipbus slave in FPGA firmware and IOC based on ipbus soft driver are developed.

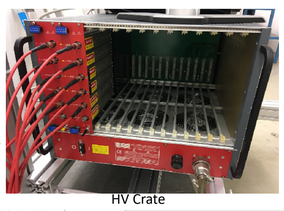


EPICS GUI ↔ EPICS IOC ↔ DPBCONTROLS ↔ FPGA Firmware ↔ GBTx ↔ GBT-SCA ↔ I2C ↔ BME280

High Voltage

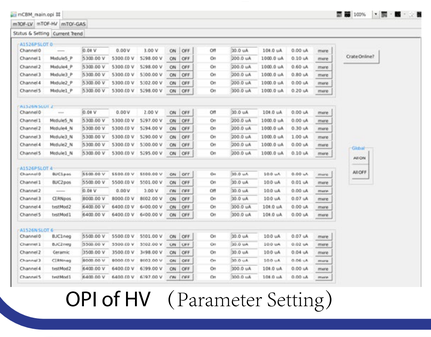
CAEN SY1527LC Crate
4 A1526 HV Board (6 Channels, 0 ÷ 15 kV range)

OPI funtions:
- On/Off switches
- Parameters setting
- Voltage/Current Monitor
- Current trend plot

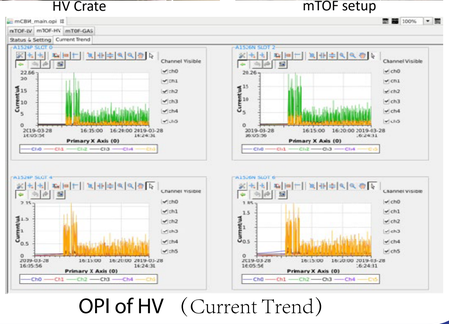


HV Crate

mTOF setup



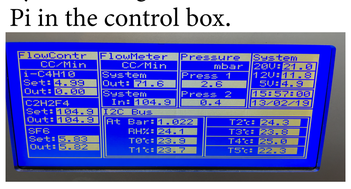
OPI of HV (Parameter Setting)



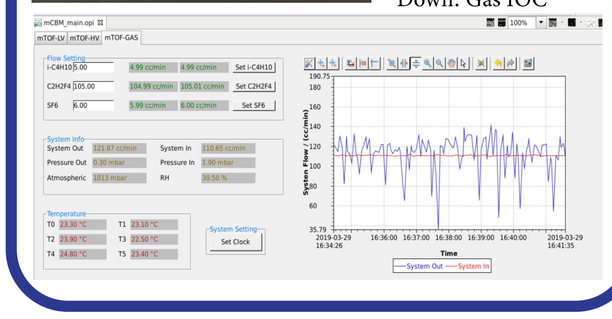
OPI of HV (Current Trend)

Gas Flow

The gas control box contains bronkhorst control units and a Raspberry Pi, and it's designed by LIP. The gas IOC runs on the Pi in the control box.



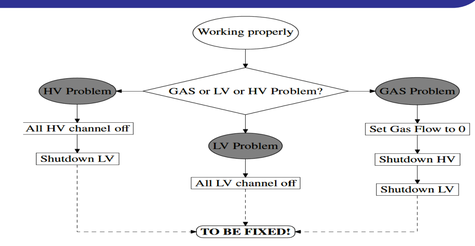
Up: Bronkhorst unit
Left: LCD on box
Down: Gas IOC

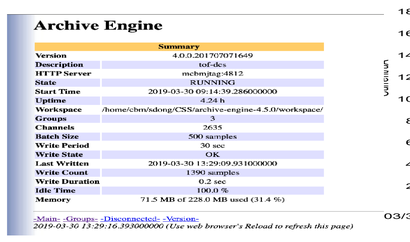


Archive And Exception Handle

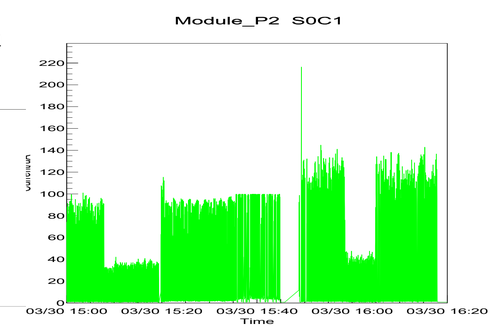
ARCHIVE:
- CSS Archive Tools
- PostgresSQL
- 2635 PV channels
- Web monitor

Exception handle:
- HV/LV/GAS
- Based on State Notation Language and Sequencer





Online web monitor



The current of HV @beamtime(30.3.2019)

Summary: To handle a large and complex physical experiment like CBM, to have a stable and scalable control system is fundamental. The detector control system for CBM-TOF is designed based on EPICS and has been tested in beam tests in 2019 at GSI. In addition to the instruments like power supply and flow control devices, the control path from the detector to FEE and DAQ is developed.

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