Slow Control System for the HADES RPC Detector

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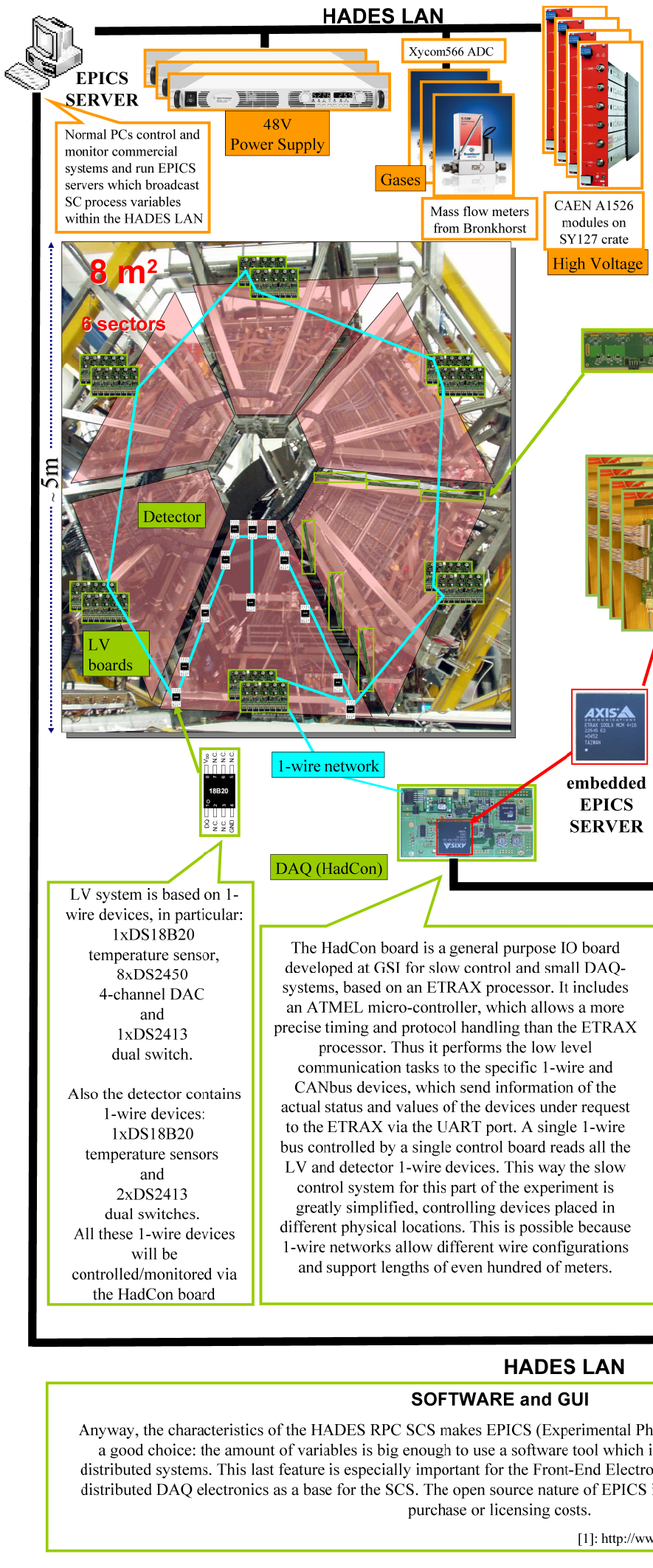
The term slow control system (SCS) refers to a computer system that monitors and/or controls one or more processes. The processes in the case of the HADES RPC wall consist of different parameters that affect the operation conditions of either the electronics or the detector. These parameters can moreover be monitored for failure prevention and detection or can be directly controlled by a client computer. The control and monitoring System designed for the HADES RPC wall attends four different systems: Front-End Electronics, Low Voltage (LV) system, detector and gas system.



CONTROL AND MONITORING PARAMETERS

- COMMERCIAL SYSTEMS
  - Gases
    - Flows
    - Oxygen content
  - High Voltage
    - Control and monitoring
  - 48 V Power Supply
    - ON/OFF
    - Voltage control and monitoring
    - Current monitoring
- CUSTOM SYSTEMS
  - LV boards
    - Temperature sensors
    - Voltage and current monitoring
    - Shutdown
  - Front-end
    - Temperature sensors
    - Switches
  - Detector
    - Temperature sensor on FEE
    - Thresholds control

The Front-End Electronics has 2232 electronic channels that require threshold setting and also monitoring of temperature. Thresholds are implemented on the Front-End boards via 8 channels LTC2620 DAC chips that provide Serial Peripheral Interface (SPI). Each motherboard (MB) contains 8 DACs connected in a daisy chain. Data is sent from the ETRAX to the first device of the chain, and clocked over the rest of the devices in the chain, programming each device to the specific values. After each programming operation the data of the registers is clocked out and readback by the ETRAX.

The existing DAQ system contains 24 TRBs, forming a distributed architecture that covers nearly 100 Motherboards, with a total of 6144 DAC channels and 96 temperature sensors. Temperature of all systems is sensed using the DS18B20 chip, which uses the 1-wire interface (MAXIM). This digital interface provides directly the temperature in a digital data word format, and allows the connection of many devices to the same bus. Each device can be addressed individually via an existing 64 bit address unique on each device. Once the search of a particular device on the 1-wire network is successful, the ETRAX processor sends a command to perform a temperature conversion and another command to read the temperature data word. Possible data communication errors are checked via a CRC word. The temperature value received is assigned to the corresponding EPICS record.

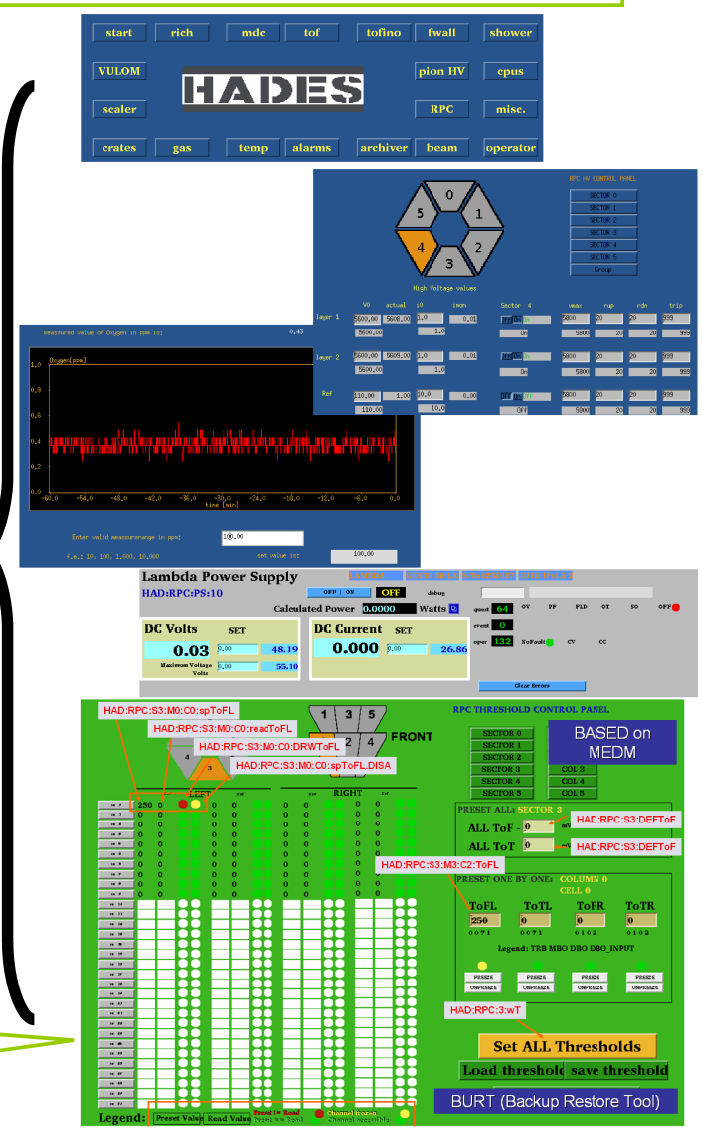
LV system is based on 1-wire devices, in particular:
1xDS18B20 temperature sensor,
8xDS2450 4-channel DAC
and
1xDS2413 dual switch.

Also the detector contains 1-wire devices:
1xDS18B20 temperature sensors
and
2xDS2413 dual switches.
All these 1-wire devices will be controlled/monitored via the HadCon board

The HadCon board is a general purpose IO board developed at GSI for slow control and small DAQ-systems, based on an ETRAX processor. It includes an ATMEL micro-controller, which allows a more precise timing and protocol handling than the ETRAX processor. Thus it performs the low level communication tasks to the specific 1-wire and CANbus devices, which send information of the actual status and values of the devices under request to the ETRAX via the UART port. A single 1-wire bus controlled by a single control board reads all the LV and detector 1-wire devices. This way the slow control system for this part of the experiment is greatly simplified, controlling devices placed in different physical locations. This is possible because 1-wire networks allow different wire configurations and support lengths of even hundred of meters.

SCS for custom hardware is also based on EPICS, with the particularity of using system-on-chip processors on custom boards as platforms for the EPICS IOC (Input Output Controller). The specific processors used are the ETRAX100LX and ETRAX FS, from AXIS Communications, which are capable of running a standard LINUX kernel. The processors, located on the DAQ system, provide 100Mbps Ethernet for remote connection. Thus, the custom boards of the DAQ system will be used not only for the readout of the detector data, but also to run EPICS servers that carry out the task of broadcasting the corresponding EPICS process variables of interest over the Network

Normal PCs running EPICS clients connected to HADES LAN can access process variables from anywhere and control and/or monitor the HADES SC system



SOFTWARE and GUI

Anyway, the characteristics of the HADES RPC SCS makes EPICS (Experimental Physics and Industrial Control System [1]) a good choice: the amount of variables is big enough to use a software tool which is scalable, stable and allows building distributed systems. This last feature is especially important for the Front-End Electronics subsystem, which makes use of the distributed DAQ electronics as a base for the SCS. The open source nature of EPICS is an additional advantage, being free of purchase or licensing costs.

[1]: http://www.aps.anl.gov/epics/ and http://wiki.gsi.de/Epics

EPICS allows integration of many channels with a distributed architecture from many different systems: commercial and custom made. The use of EPICS has the advantages of being free of purchase or licensing costs, providing reliability even for applications that require the handling of large amount of variables, not requiring big hardware resources and being extremely adaptable.

The existing DAQ readout platform is used for part of the slow control (FEE), reducing the need of a dedicated hardware for this part of the SCS.

A 1-wire network will be used for the LV and Detector SCS. The use of this bus simplifies the control and monitoring of devices physically separated and distributed all-over the detector system, requiring only the use of a single control board.

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