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The Hardware of the ATLAS Pixel Detector Control System

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The innermost part of the ATLAS experiment will be a pixel detector, built around 1750 individual detector modules. To operate the modules, readout electronics and other detector components, a complex power supply and control system is necessary. The unique power, grounding and control requirements are described, along with the custom made components of our power and control systems. These include remotely programmable regulator stations, the power supply system for the optical transceivers, several monitoring units and the interlock system.

Summary

The requirements of the pixel detector have made specific developments necessary for the hardware components of the detector control system. An efficient operation requires a preferably individual adjustment of the different control parameters. Further design constraints are the high power density in the detector volume, the floating grounding scheme of the ATLAS detector and the sensitivity of the read out chips developed in deep sub micron technology. Especially the power supply system, consisting of nearly 5000 individually controllable supply lines, requires solutions which are adapted to the detector needs and which in parallel are economically priced. The remotely programmable regulator stations, which are installed as close as possible to the detector modules, provide individual floating power outputs with low ripple to the front end electronics. At the same time they protect the sensitive chips against transients. The internal control of the regulator station is handled by a FPGA from Actel, while the link into the control system is handled by the ELMB, the ATLAS wide used front end IO unit. The design of the supply system for the opto transceiver boards is based on components, which can directly be controlled by the ELMB. In this way a reasonable priced solution has been found which allows individual

setting and adjustment for
each of the more than thousand channels.
In the positions where common power supplies are used to
provide voltages to several
loads additional monitoring units are integrated which allow
to investigate the
behaviour of individual modules. The design constraints,
precision and compatibility
to the ATLAS grounding scheme, are fulfilled by the
presented LV and HV monitoring
systems. In this way more than 8000 monitoring channels
complete the low and high
voltage system.
As specially irradiated detector modules can be destroyed by
heat ups, a thermal
interlock system is developed which acts directly on the
related power supplies. In
addition other equipment can suffer from extreme heat and
human being must be
protected against risks due to lasers. Therefore these
devices are connected to the
interlock system as well. The presented interlock matrix,
whose design is based on
the use of a FPGA, allows a dedicated control of small
equipment groups and helps in
this way to keep the number of channels out of service as
low as possible.
All presented hardware components passed intensive
electrical studies and
investigation in our system tests and are currently under
production. To simplify the
production and to have an easy maintenance the systems
are built in a modular way,
combining different building blocks. As everywhere the
ELMBs are used for
communication, the integration into the ATLAS wide control
system can easily be
performed.

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