Documentation of ATLAS SCT End cap Module QA Site

Charles University, Prague

Introduction

Charles University at Prague (Institute of Particle and Nuclear Physics, IPNP) is one of the institutes collaborating at the CERN LHC ATLAS project. In the SCT subsystem, the group of the university is participating at the end cap module development and production. One of its commitments is to perform quality assurance of the SCT end cap modules assembled in MPI Munich before they are shipped to disk assembly sites (Liverpool, NIKHEF). The IPNP group is supposed to test about 200 modules (half of the total 400 modules assembled in MPI).

QA procedure

The following steps of the QA procedure will be performed in Charles University:

1. Visual inspection after reception from Munich
2. Long-time electrical and IV test: 24 hrs@ 10 deg C
3. Full characterisation @ 10 deg C
4. Sample beta source scan
5. Sample laser scan

Environment and equipment

1. Clean room, 20 m^2 class 10.000 with 2 laminar flow boxes
2. Grey room, 10 m^2
3. Stereo microscope
4. SCT readout system (Mustard, SLOG, CLOAC, SCT LV3, SCT HV, AERO)
5. NI PCI-VME, PC with Windows 2000
6. Chiller JULABO F25 MD, -30 to 120 deg C
7. Dry air system (oil free compressor + condensation dryer)
8. Valencia module test boxes
9. 6-module test box with cooling and dry air manifolds,
10. Environmental monitoring system (temperature, pressure, humidity)
11. DCS PC with an extensive detector control system software
12. Beta source test setup
13. XY stage with 5 um precision
14. Laser, ns-pulse length, wavelength 650 nm (borrowed from CTU)
15. Digital oscilloscope Hewlett Packard

Personnel

QA process will be performed by:

- Jan Brož, Zdeněk Doležal, Peter Kodyš, Petr Kubík, Jan Švejda (staff members)
- Zdeňka Broklová, Pavel Řezníček (students)

Detailed setup description

Modules are tested in the clean room (see Fig. 1), where the 6-module test box (Fig 2a, 2b) with 6 Valencia boxes in is installed. The scheme of the setup is displayed at Fig. 3. DAQ system is in the clean room together with beta source test and laser test setup with XY stage with 5 um precision (Fig. 4). The most of the detector control system is located in the grey room (Fig. 5). DAQ (standard SCT DAQ) and DCS (prepared specially for Prague setup) are thus physically separated. The clean room is equipped with 2 laminar flow boxes. There is a standard temperature and humidity monitoring and logging system.
6-module test box is flushed with dry air from the system consisting of oil free compressor Schneider Profimaster 200-25, HIROSS HFN005S super fine filter and HIROSS condensation dryer Starlette SGB002 (Fig. 5).

Data Acquisition

This is a standard SCT module readout system (Fig. 6), which consists of several VME cards (Mustard, SLOG, CLOAC, SCT LV3, SCT HV, AERO – not yet available), with an interface to PC (NI PCI-VME). SCTDAQ is run under Windows 2000.

Detector Control System

Detector control system was set up especially for the Prague setup to set and monitor environmental and working parameters for module testing (Fig. 7). It is controlled independently from DAQ, but both systems are communicating via shared disk files. This allows automatic safe shutdown of module testing (HV ramp down, LV Off, etc.) if the required environmental conditions (temperature, humidity) are not met, or if there was a power cut.

Basic features of the DCS software:

- platform: Windows 2000
- development environment: National Instruments LabWindows/CVI
- reading information
    - from National Instruments AD card PCI-6023E
    - from other sensors via RS232
- Semaphore files indicating DAQ or DCS status and are used for programs communication
- periodical DAQ data backup on DCS computer and vice versa
- Logbook
    - fully automatic
    - all parameters and history of measurement saved
- test status is displayed at periodically refreshing web page (via FTP)
- partial remote control via VNC is enabled
- enable automatic mode
    - in case of problem the system alerts person on shift via light alarm, e-mail, SMS, phone call
    - in case of accident automatic ramp down of voltage on modules and end of testing

Monitored parameters

- temperature of coolant in Julabo chiller
- temperature in the test box
- temperature of coolant going out of the test box

- temperature in the test box measured by independent sensor
- humidity in the test box
- overpressure in the test box
- electric power
- connection between computers

Detailed procedure description

1. Reception, visual inspection

The modules will be unpacked and visually inspected in the clean room under the magnifying glass, or microscope. At the same time, new traveller sheet will be filled in.

2. Installation in the box

Afterwards, they will be placed into the Valencia module boxes. These boxes will be covered with lids, positioned to the 6-module test box and connected to the cooling, dry air manifolds and power and readout system. The box will be light tight covered. Then cooling and dry air system will be switched on and a detector control system will be started on DCS PC.

3. Basic functionality test

At the same time, readout system will be started, modules powered up and first trigger bursts taken. This is to ensure, that modules are principally functioning. Then detector bias will be ramped up. All three measured currents (I_{cc}, I_{dd} and I_{det}) will be recorded to the traveller sheet.

4. Long term tests

After the temperature reaches 10 degrees on the hybrid thermistors, and other environmental parameters are met, long-term electrical tests are started at the DAQ PC. The person on shift checks the functionality of the DCS, level of chiller coolant, etc.
After confirmation sequence is performed, the person on shift checks results of three-point gain measurement.

5. Characterisation sequence

After 24 hours of long-term tests characterisation sequence is run. After finish database upload macro is run and the results automatically backed up. Person on shift has to check if it was successful and log it into the traveller sheet, and upload the results to the SCT Database.

6. Module classification

After the characterisation sequence the results are reviewed by the QA site manager. The modules that passed all tests are removed from the system and stored in a module container. The modules that showed problems are investigated and some tests may be rerun.

7. Sample tests

A small fraction of the modules (about 10%) will be subject to sample testing using laser or beta source. The strip-to-channel matching is checked. The percentage of the modules subject to these tests will evolve with experience.

8. Packaging and shipment

After 12 modules are tested, they are packed and shipped to the disk assembly site (Liverpool or NIKHEF). The detail of packaging and shipment are yet to be defined.

9. Figures

Figure 1. Charles University, Prague - clean room – general view to testing place

Figure 2a. Test box for six modules with cooling system, sensors and gas distribution

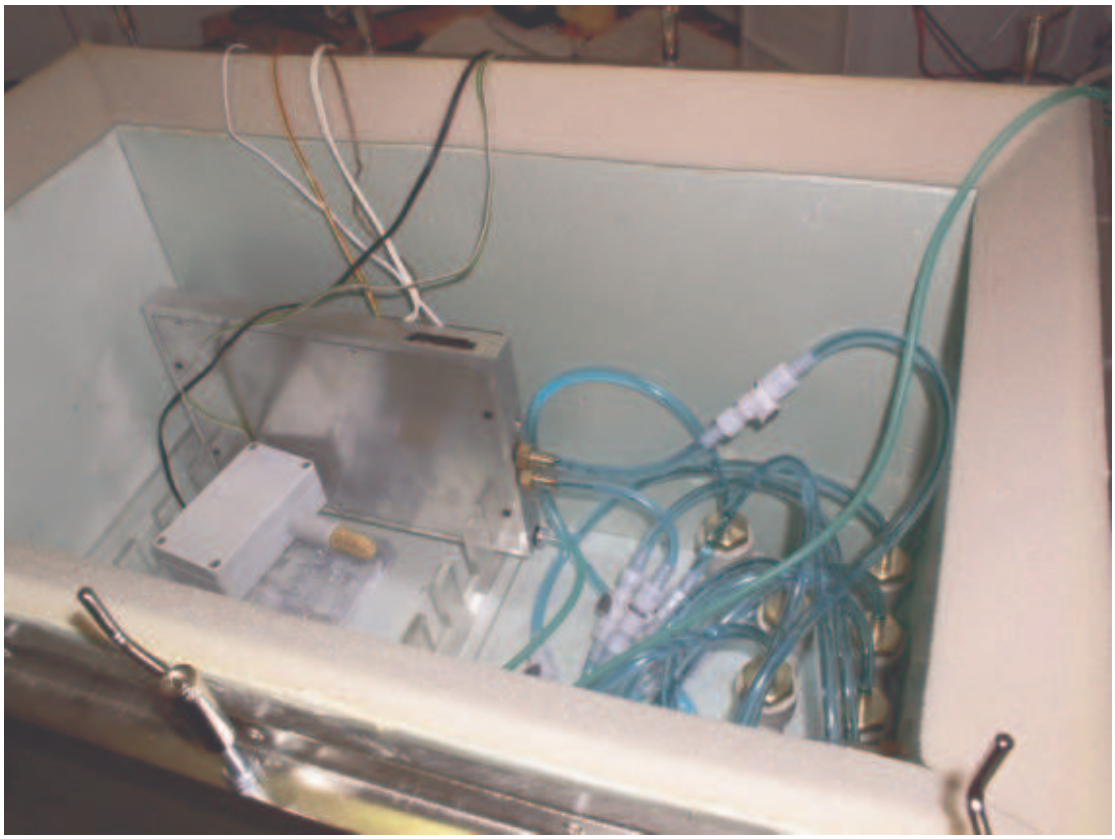

Figure 2b. Test box for six modules – view inside

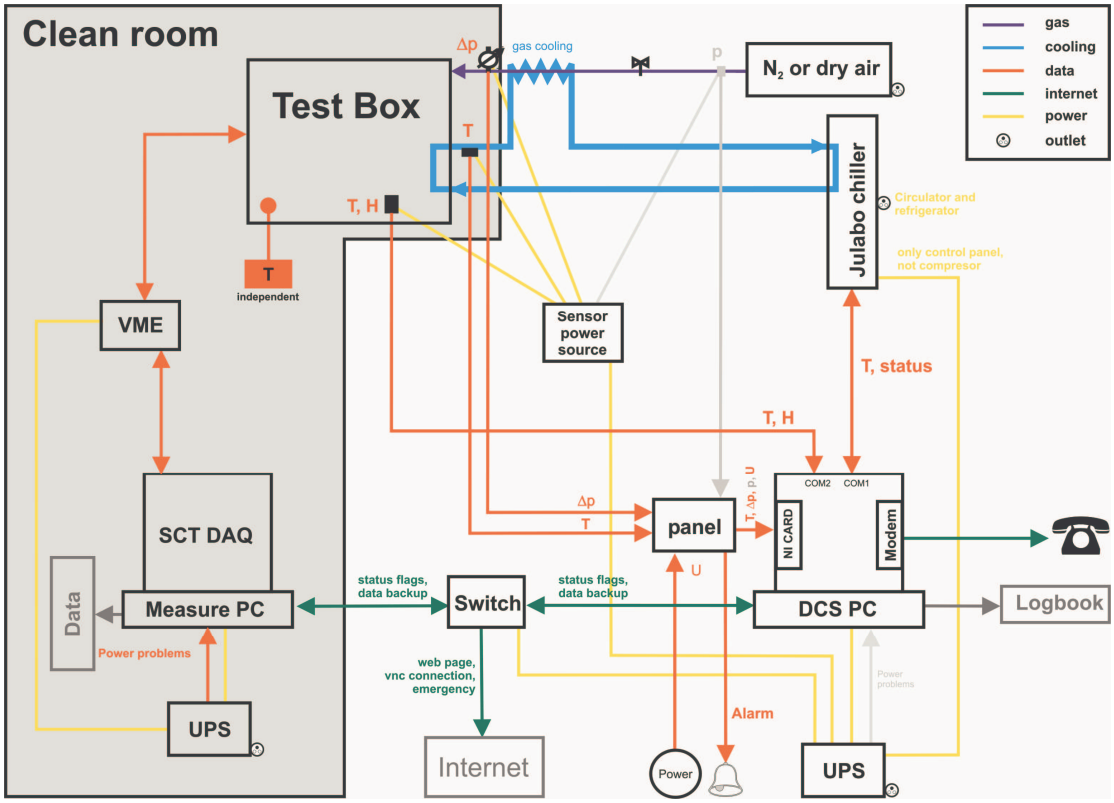

Figure 3. Scheme of DCS arrangement in Charles University, Prague

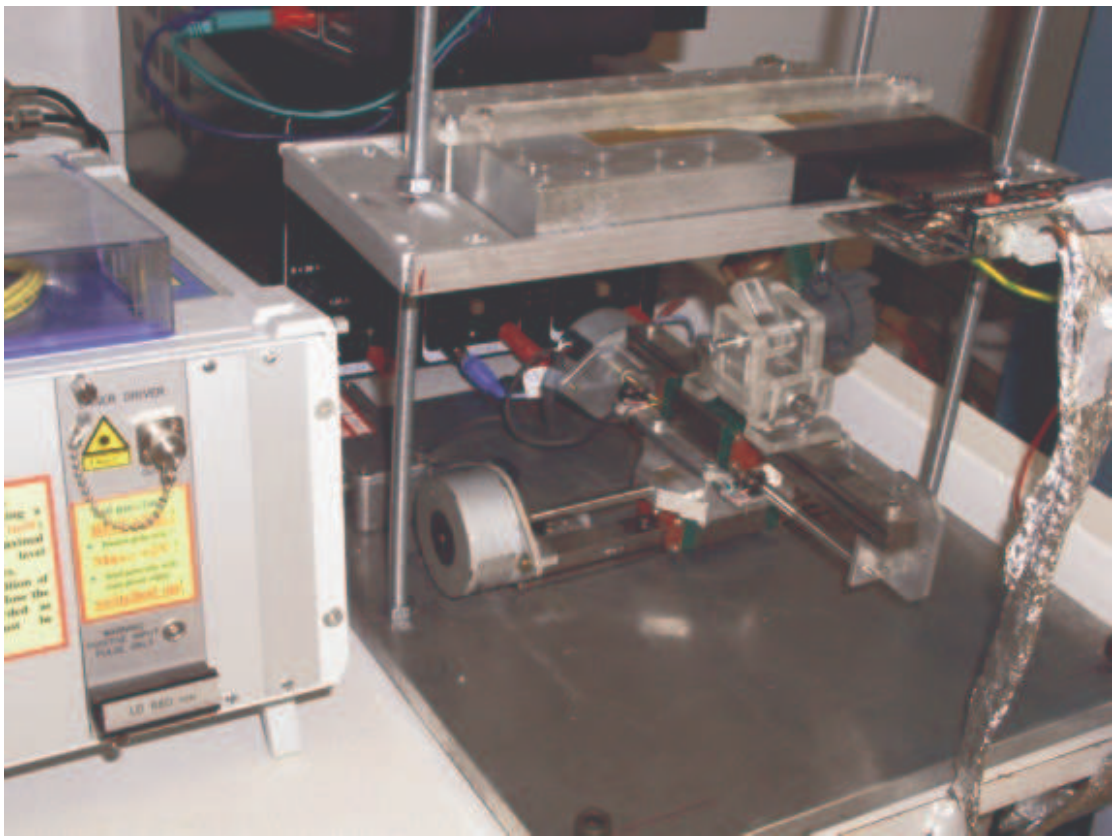
Figure 4. Detail view to place for beta source test and laser test setup with XY stage with 5 um precision

Figure 5. Charles University, Prague - grey room – general view to DCS control place with chiller “Julabo”, dry air source, sensors and test box for six modules

Figure 6. Readout system in VME crate (left) and place for beta source test and laser test setup with XY stage (right)

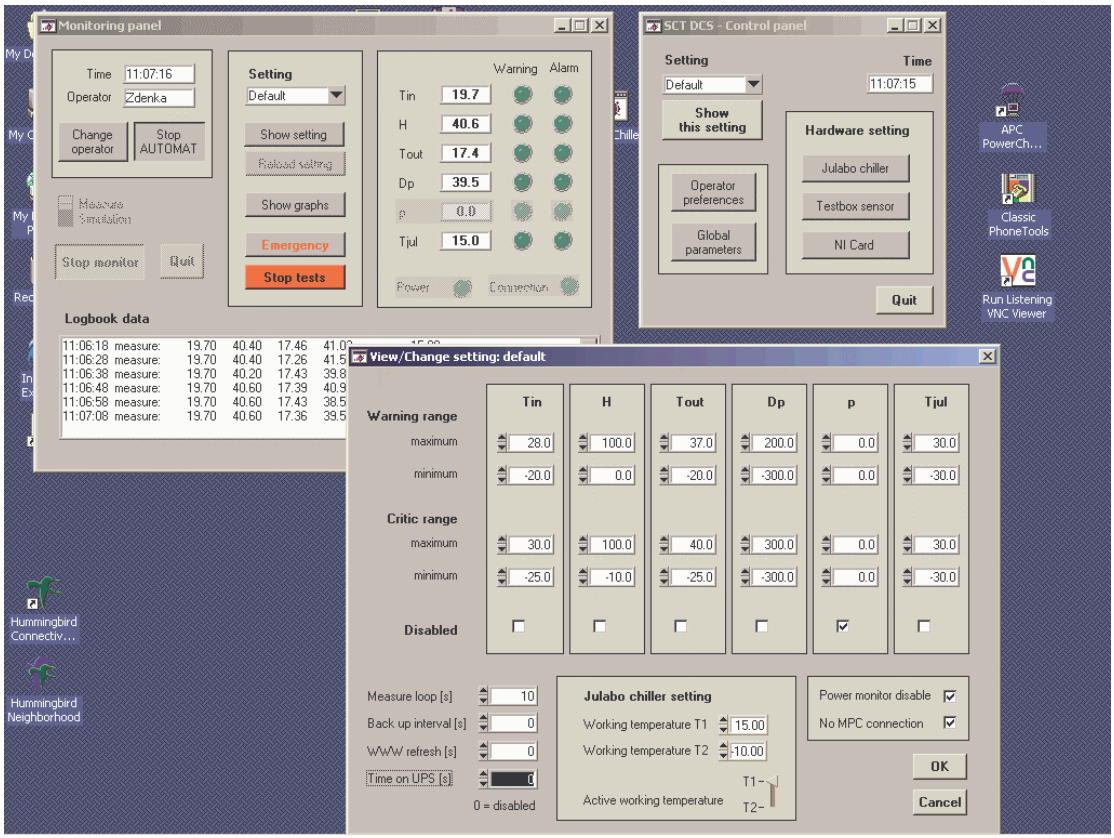

Figure 7. Screen shot from main DCS control program