WP4 Technical Design Document 16/01/15 K.H. Becker

The Slow Control Unit (SCU) for the Auger Surface Detector upgrade was decided to be running on a separate micro controler (uC). This simplifies the development of the data aquisition system. The tasks, data aquisition and slow control, can be independently operateed. This document describes the technical design of the SCU.
Respectively to the Critical Design Review Plan (Ref. WP10LPSC14C) this document has the following chapters:

- Specific requirements

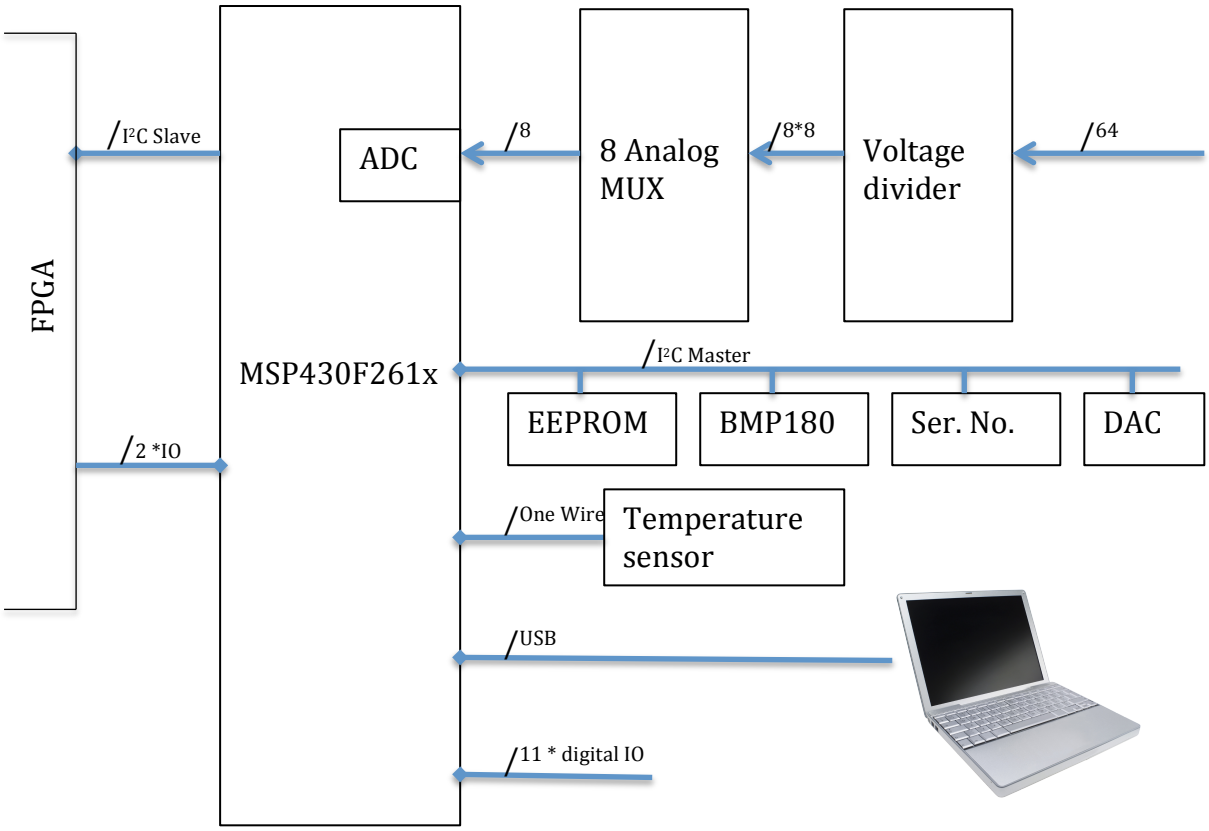
Concerning the Specifications Document (WP10LPSC01C) the the SCU has to fulfill the following requirements:

- 64 ADC channels (12 bit wide) for PMT voltage and current, power supplies and the solar power system monitoring
- 8 buffered DAC channels (0-2.5V) for PMT high voltage control
- 8 digital inputs and outputs
- monitotoring of atmospheric pressure and water temperature sensors
- serial USB interface for maintenace
- ADC input impedance should be at least 10k ohms

- Design concept and solution selected

A solution similar to the AERA SCU was chosen with a uC of type MSP430F2618. In this design the 64 ADC channels are multiplext by 8 analog multiplexer of type ADG608 and digitized with the MSP430 on-chip 12 bit ADC.
To protect the on chip ADC, the analog input signals are divided to the range 0-1 Volt. The ADC reference voltage is set to 1.5 Volt, this gives a resolution of 1.5 Volt/$2^{12} \approx 0.36$ mV.
For the DAC channels we use a LTC2637 connected to the I^2C master port of the uC.
To this port there are also are also connected a pressure sensor BMP180, an EEPROM 24LC256 and a 64 bit registration number IC DS28CM00.
The EEPROM will be used to store system variables like ADC threasholds and logging records for maintenance.
A standard commercial temperature sensor (DS18S20) in waterproof housing is connected via OneWire-bus, implemented by software.
The datasheets for the integrated circuits used for the SCU are collected at http://astro.uni-wuppertal.de/~becker/sde_upgrade/ .

- Design implementation, schematics



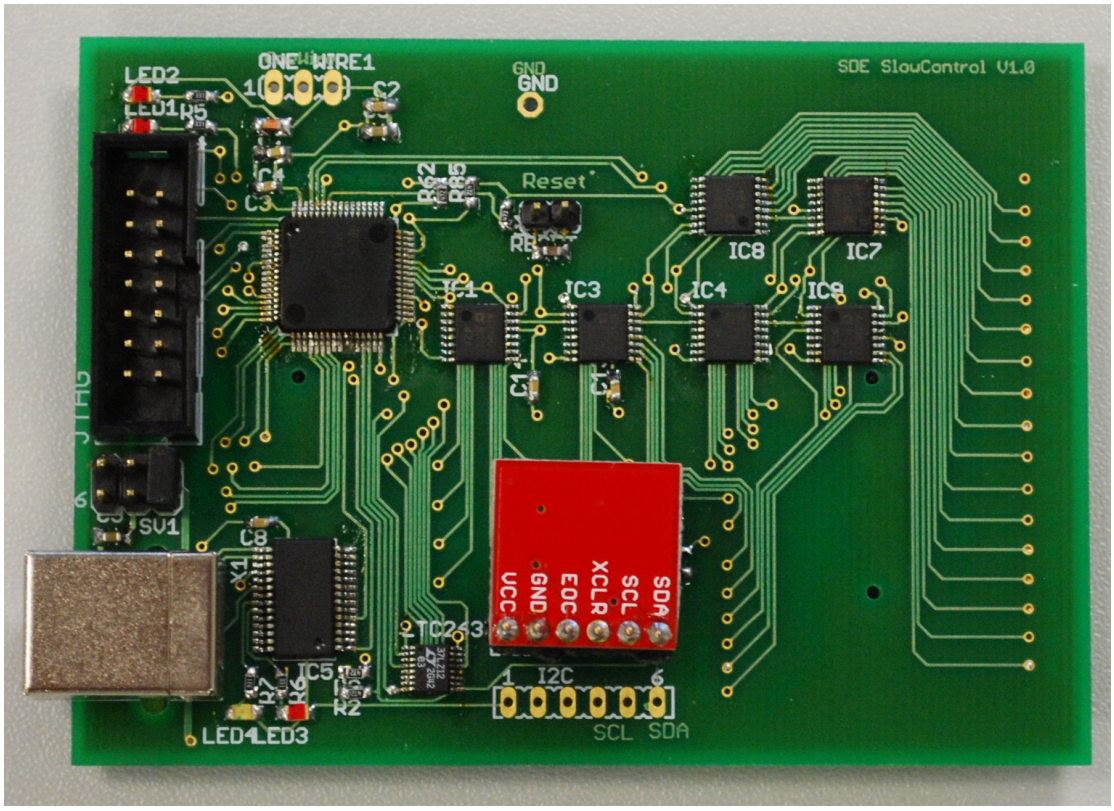
Block diagram of the slow control unit

The full schematics of the SCU as built into the UUB can be found here:

http://astro.uni-wuppertal.de/~becker/sde_upgrade/slow-control_2014-07-03.pdf

- Prototype test board design

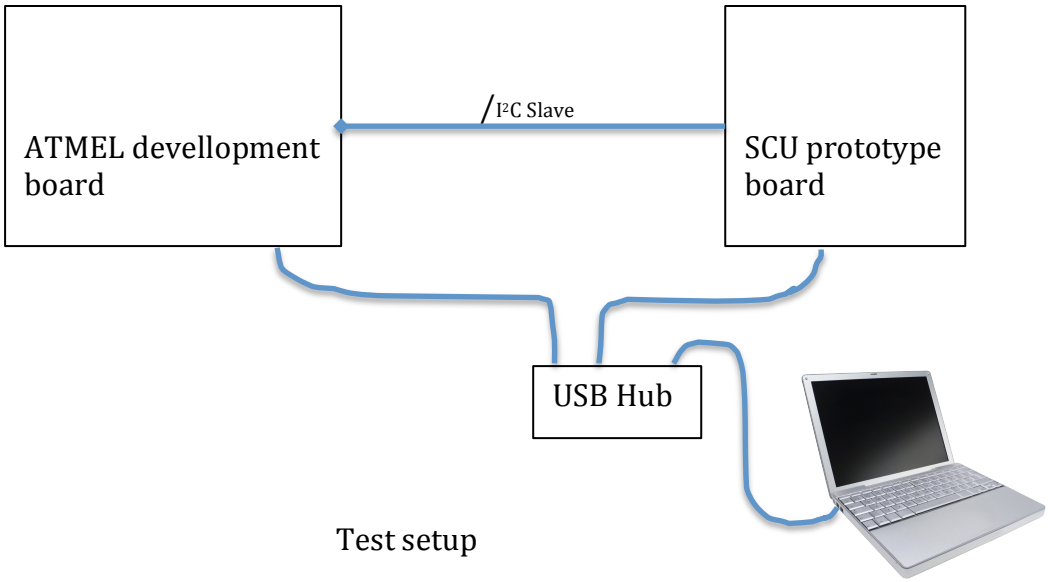
In the beginning of the development phase, it was planned to implement the SCU as a plug-in unit, at least for the prototype boards. Due to the simplicity of the schematics this plan was changed and the SCU is directly built into the UUB. At this time a first version of the SCU is already built as a separate unit and is used for software development and testing of the various functional blocks.
This board does not fulfill all requirements i.e. it has only 48 instead of 64 ADC channels but has all sub circuits on it.



Picture of the SCU prototype board

- Test report and results on prototype

Tests have been done by connecting the I²C slave port of the SCU to a ARDUINO LEONARDO, a commercial devellopment board. It comes with an open source programming environment and uses also an USB port for communication. Both USB ports are connected to a terminal program running on a Laptop.
With this setup, commands can be send from the terminal to the ARDUINO board, there converted into I²C messages and sending them to the SCU. On a second terminal window debugging messages from the SCU can be displayed.
The SCU is programmed via JTAG, using a MSP430 programming interface (MSP-FET430UIF).
Test programs are written in “C“ and compiled with the MSP430-gcc compiler.
All components used by the SCU work as expected, compared to their datasheets.



Test setup

- Design status

The SCU design is frozen and we are waiting for the first UUB-prototype boards.

- Presentation viewgraphs

WP4 presentations to the working group meetings are collected here:
http://astro.uni-wuppertal.de/~becker/sde_upgrade/slides/ .