Further Development of the APFEL - ASIC for the PANDA Calorimeter *

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Introduction

In 2012 the PANDA collaboration started to develop a first prototype for the barrel part of the PANDA electromagnetic calorimeter. The prototype consists of 120 PWO crystals which are equipped with 2 avalanche photo diodes (APD). These APDs are read out with the further development of the APFEL- ASIC (ASIC for PANDA Front-End ELectronics) which is developed at GSI. The APFEL-ASIC architecture is described in [1].

Readout Electronics

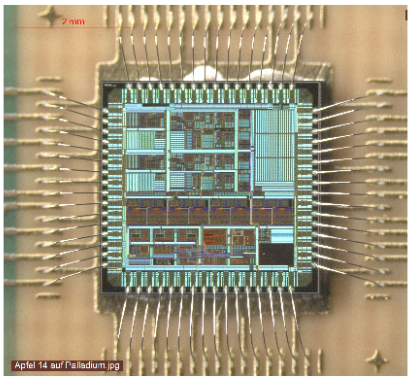

Figure 1: Photograph of the APFEL 1.4 - ASIC

A picture of the present APFEL - ASIC is shown in figure 1. On a chip area of 3.5 x 3.6 mm ^{2} two equivalent analogue channels and a digital part is implemented. Each analogue channel consists of a charge sensitive amplifier, a shaper stage and differential output drivers. After the first integrator stage the signal path is split into two sub paths. One of these sub paths has a programmable amplification of 16 or 32 in comparison to the other to get larger output signals in the low energy range. A schematic overview of the ASIC is presented in figure 2.

The further development of the APFEL - ASIC includes a decoupling of the first shaper stage of the two readout channels. Therefore a fourth DAC is implemented which was necessary to correct now all temperature and process variations for both channels individually. An essential design change is the programmable amplification. Therefore the second shaper feedback in the high amplification part is switchable. Using the serial receiver the amplification can be programmed. The present ASIC iteration also includes a new test pulser concept. For each channel four different charge injection capacitors are available so by combination in total 15 different pulse hights per channel are programmable.

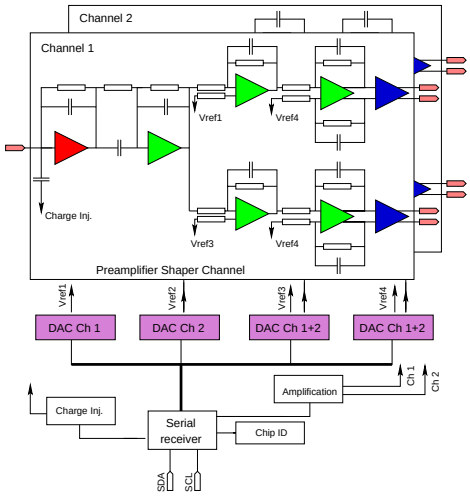

Figure 2: Overview of the ASIC architecture

Measured Results

The characterisation of the latest ASIC iteration at a temperature of T = $-25\,^{\circ}$C and a detector capacitance of 280 pF results in an equivalent noise charge of ENC=(4999$\pm$71) e$^-$ (or 0.78 fC) and a maximum input charge of 8.5 pC. Therefore a dynamic range of over 10 000 follows. The peaking time of the shaped signal was measured to τ_p=(248$\pm$3) ns. The event rate independent power consumption of one channel is P=(59$\pm$0.5) mW.

Summary and Outlook

The current design of the APFEL - ASIC is optimised for the effective conditions of the PANDA experiment and will be used for the barrel prototype 120. Therefore 120 flex cable PCB are designed and produced where the ASICs will be assembled. In spring 2013 the prototype 120 will be mounted and prepared for the beam time end of 2013.

References

[1] P. Wieczorek and H. Flemming, “Low Noise Preamplifier ASIC for the PANDA EMC”, IEEE Nuclear Science Symposium 2010, Knoxville, USA, NSS-N47-74, Published in NSS/MIC, 2010 IEEE DOI: 10.1109/NSSMIC 2010.5873982 Page 1319 - 1322

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