APFEL 1.5
An Integrated Preamp and Shaper for PANDA EMC

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Outline

Motivation and Requirements

History

Circuit Overview

Realisation

Measurements
- Noise
- Dynamic Range
- Power Consumption

Summary and Outlook

Motivation and Requirements

- Very compact mechanical design $\Rightarrow$ High integration of electronics
- Operation in cooled area $\Rightarrow$ low and rate independent power consumption
- Spectroscopic use $\Rightarrow$
  - Low noise
  - Large dynamic range > 10000
- High rate capability > 300 kHz
- Limited access during operation $\Rightarrow$ High reliability

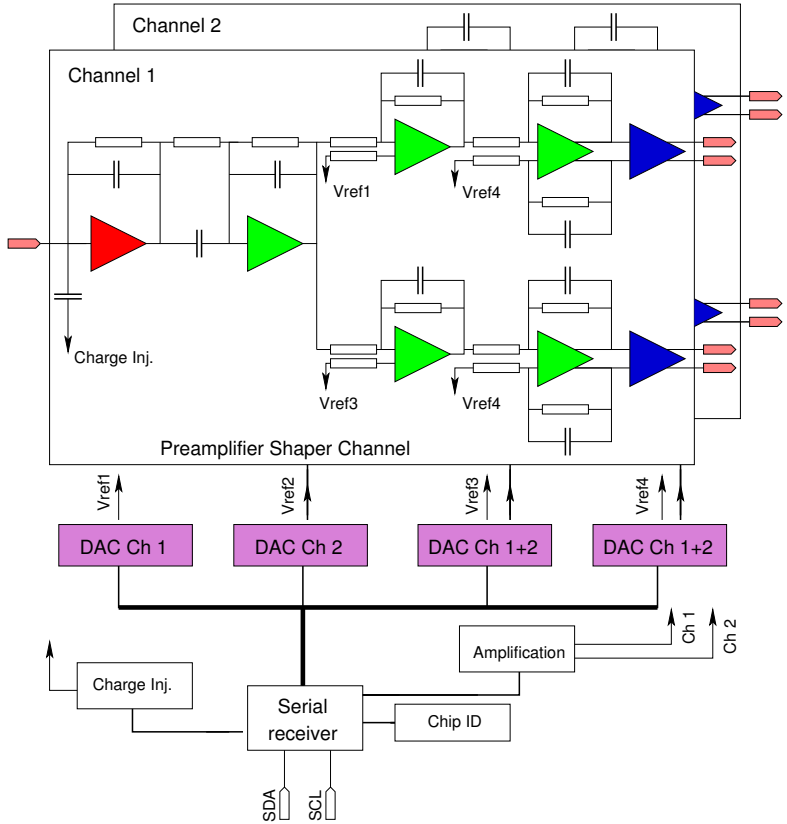
$$\Rightarrow \text{APFEL 1.5}$$

History

Version	Year	Features
APFEL 1.1	2006	First test chip, four channels with different shaper, external references
APFEL 1.2	2007	Two channels, dual dynamic range outputs, internal references with programmable DACs
APFEL 1.3	2010	Auto calibration mode for references test beam at MAMI, integration at TASCA, offset between channels
APFEL 1.4	2012	Additional DAC for separation of channel offset correction, programmable amplification
APFEL 1.5	2013	Bug fix in digital interface

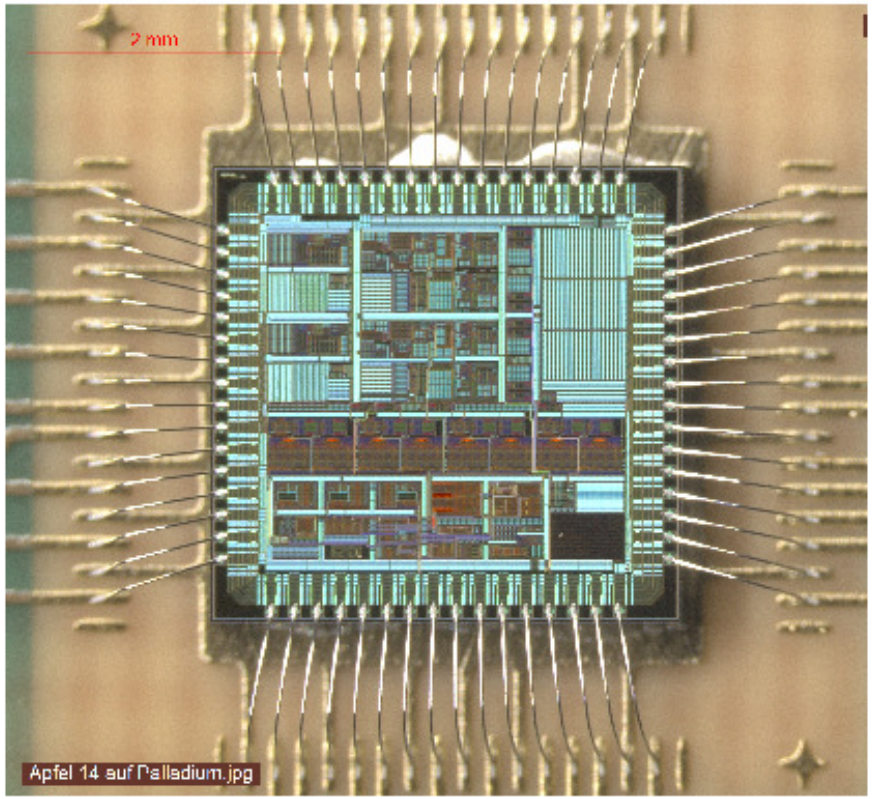
APFEL 1.5 Overview

- Two independent channels
- Charge sensitive preamplifier
- CR-RC shaper with 3rd order integrator
- o' Conner schema pole-zero-cancellation
- Dual range output with configurable amplification: 16/32
- Configurable voltage references for baseline adjustment
- Configuration via three-wire serial bus



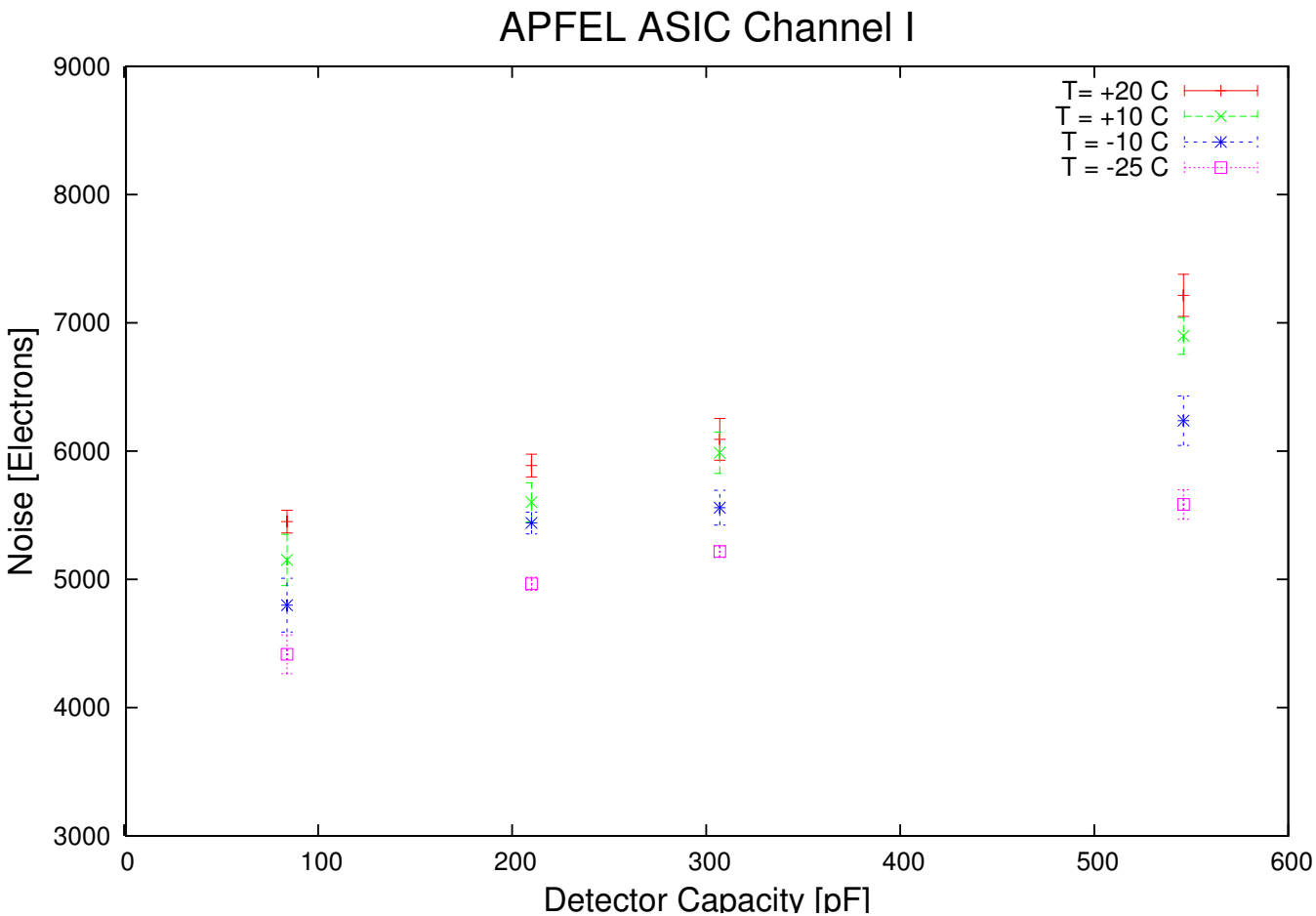
Realisation

- AMS 350 nm 2P4M CMOS technology
- 3.4×3.5 mm^2
- Single voltage supply 3.3 V
- TID tested up to 3 kGy



Measurements

Noise

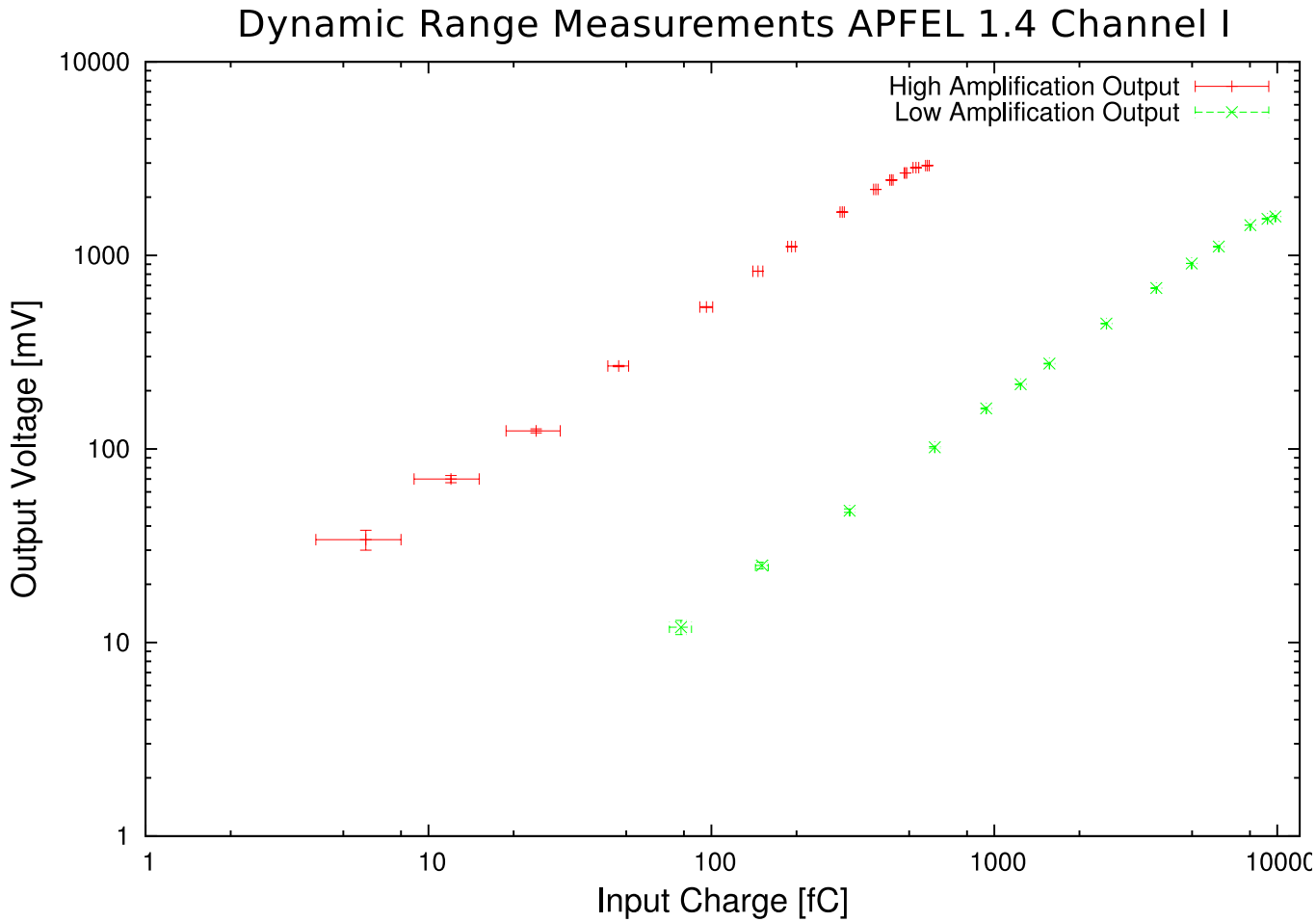


$$ENC = (4234 \pm 143)e^- + (3.3 \pm 0.31)\frac{e^-}{pF} \cdot C_{det} + (23.75 \pm 0.31)\frac{e^-}{K}(T - 246K)$$

$$C_{det} = 280pF, T = -25^\circ C \Rightarrow ENC = 5206 \pm 167e^-$$

Measurements

Dynamic Range

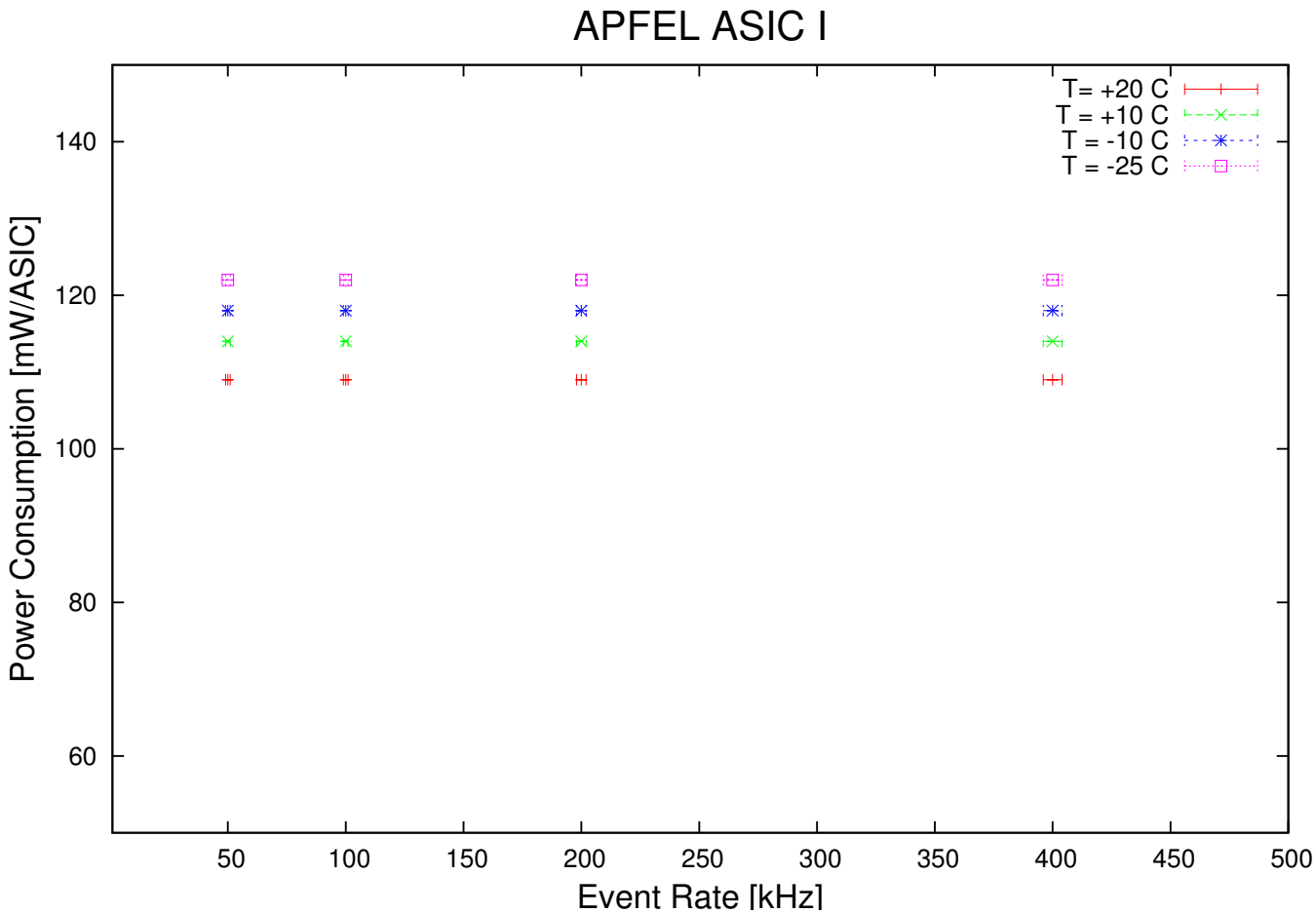


Upper limit of dynamic range : 8.5 pC

$$\Rightarrow d = 10365$$

Measurements

Power Consumption



No rate dependency observable! Temperature dependency: -0.09 mW/K

$$P = 59 \text{ mW/ch @} -25^{\circ}\text{C}$$

Summary and Outlook

- Integrated preamplifier for PANDA EMC is available in fifth iteration
- Measured performance meets specifications

- Proto120 will be equipped with APFEL 1.4
- Beam tests hopefully end of this year