

Current development of the next generation of PSI digital controllers

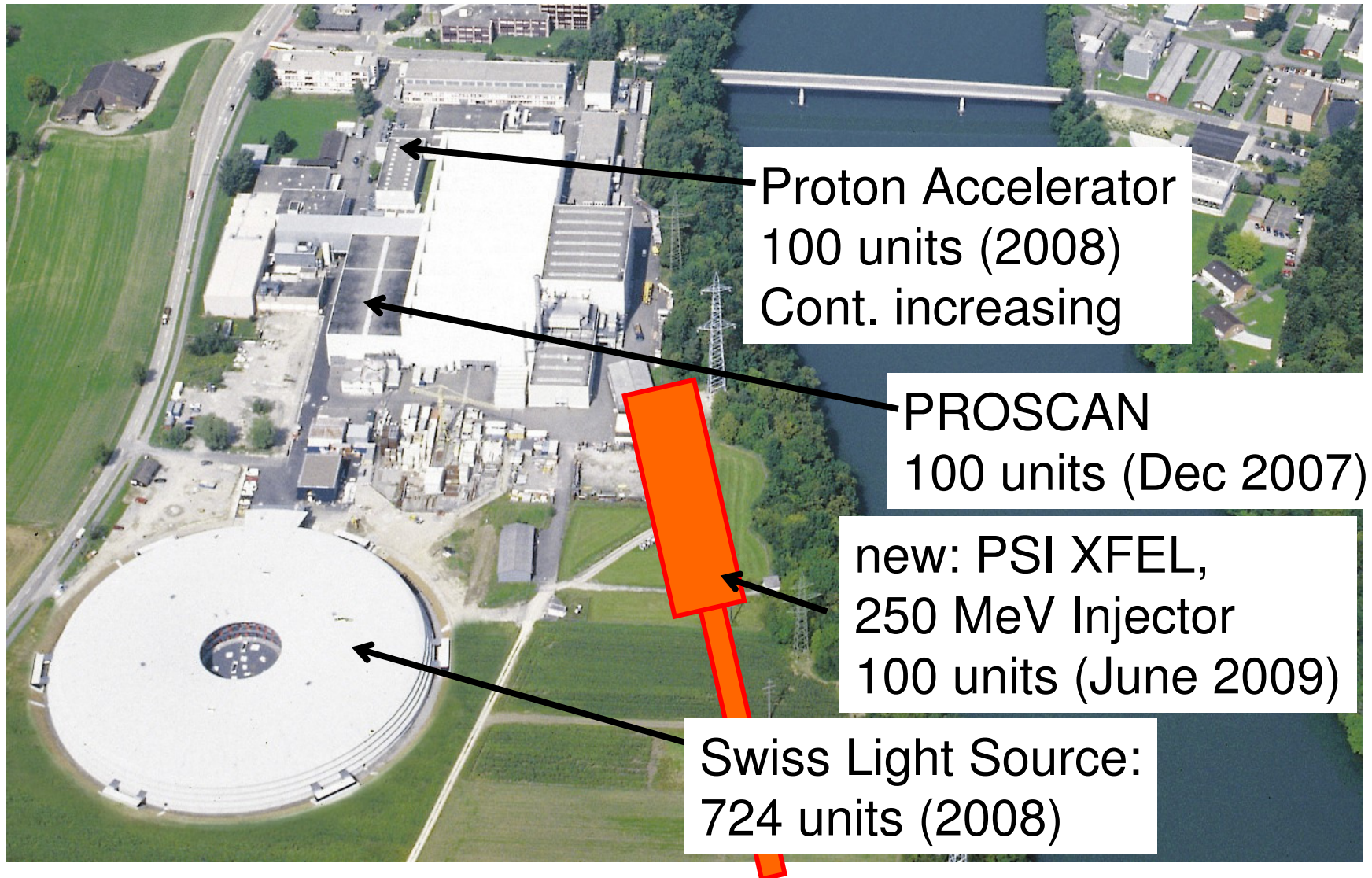
The DPC Project

DPC= Digital Power Electronics Control System

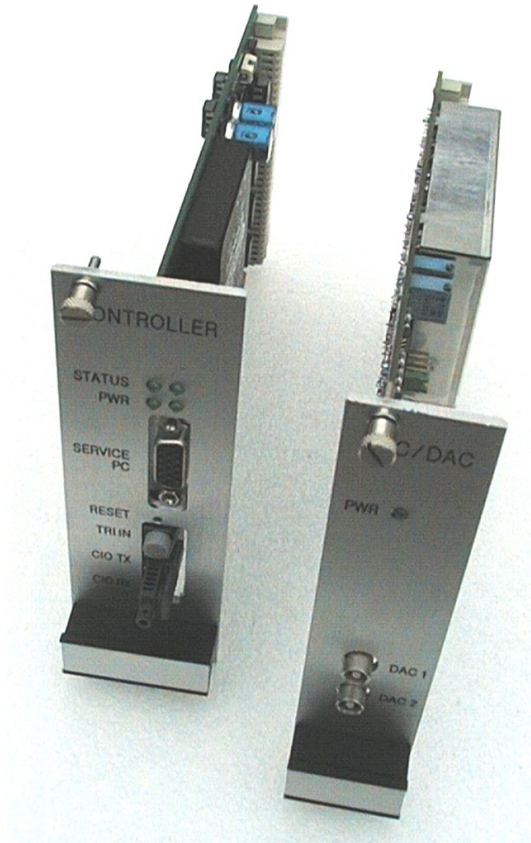
presented by

Martin Emmenegger

Digitally Controlled Power Supplies at PSI



The first generation of PSI Power Supply Controllers PSC



Experience

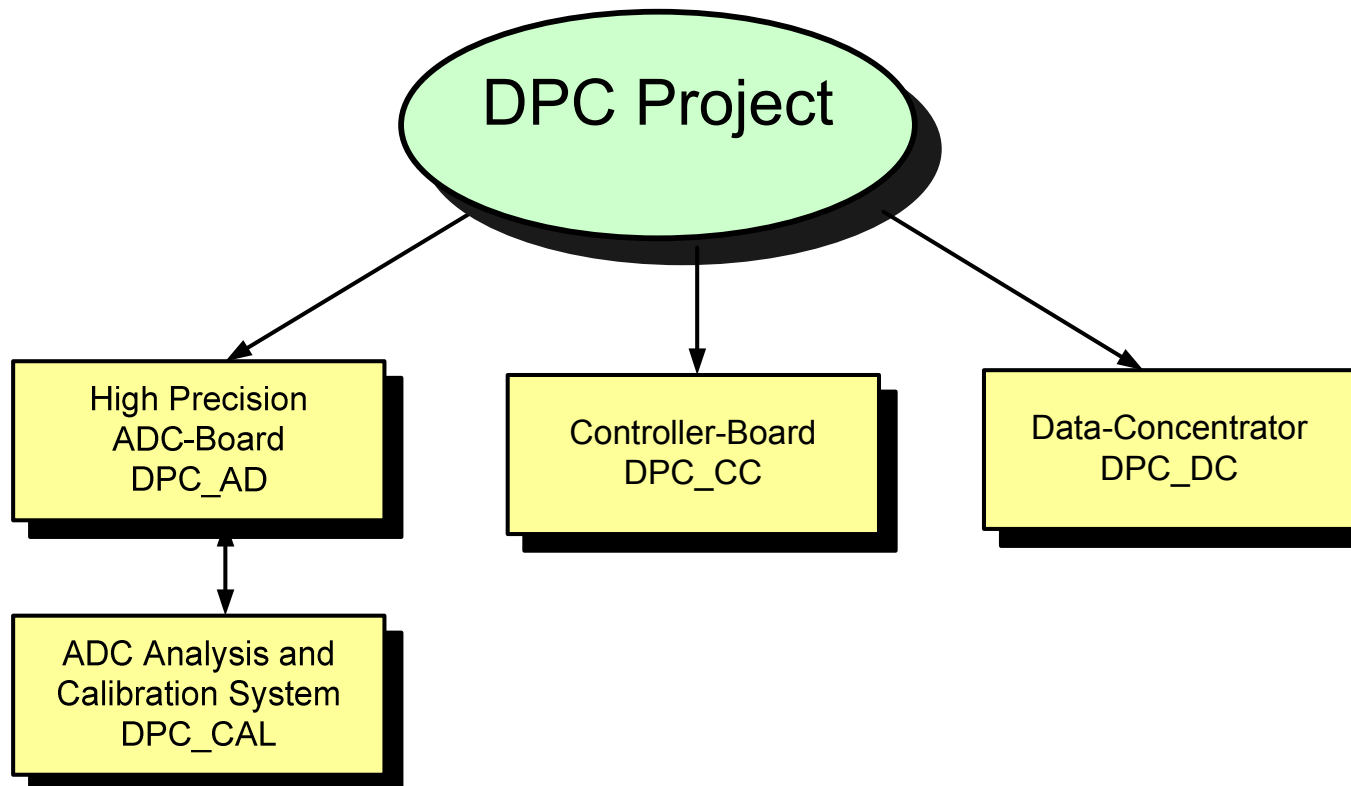
- Same HW and SW for many different applications
- Very fast commissioning phase including integration into the control system
- Very low fault rate
- Comprehensive diagnostics leads to minimized repair time in case of a fault
- Highly satisfied customers

Suggestions from PSC-customers

- Increase ADC resolution
- Improve ADC long-term stability
- Reduce latency to the orbit feedback system
- Provide a connection to open networks (Ethernet)
- Design a cost effective solution
- Design for fanless operation

The DPC Project

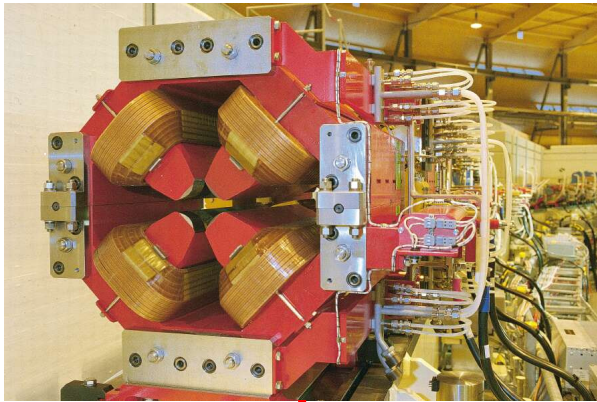
DPC= Digital Power Electronics Control System



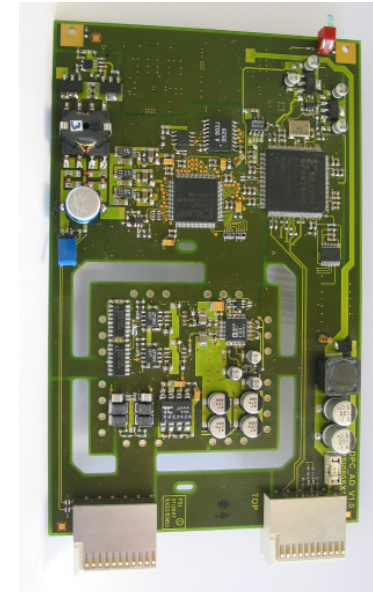
Sub-Project I

High Precision AD-Converter

Magnets



AD Converter
DPC_AD

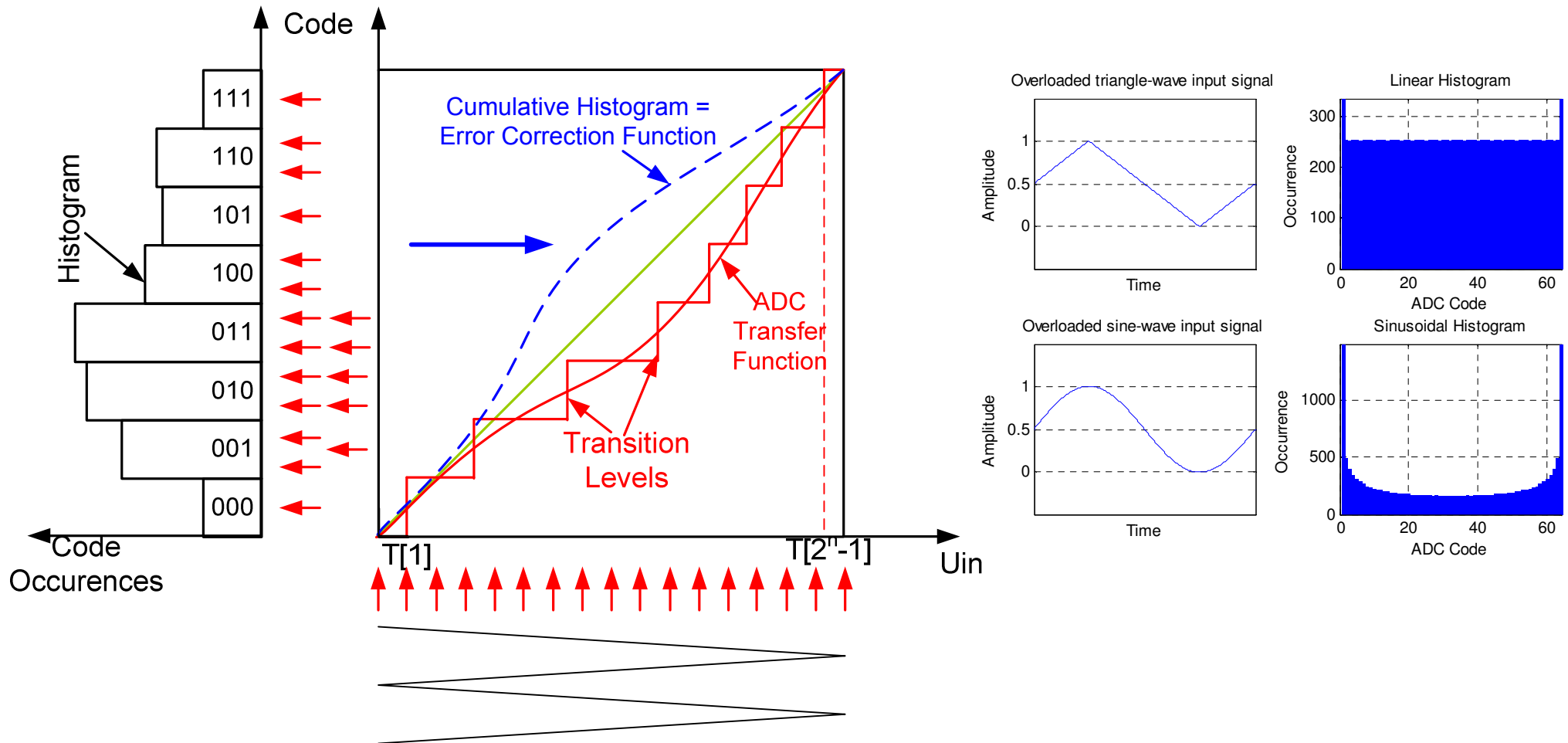


Current Transducer
Zero Flux DCCT

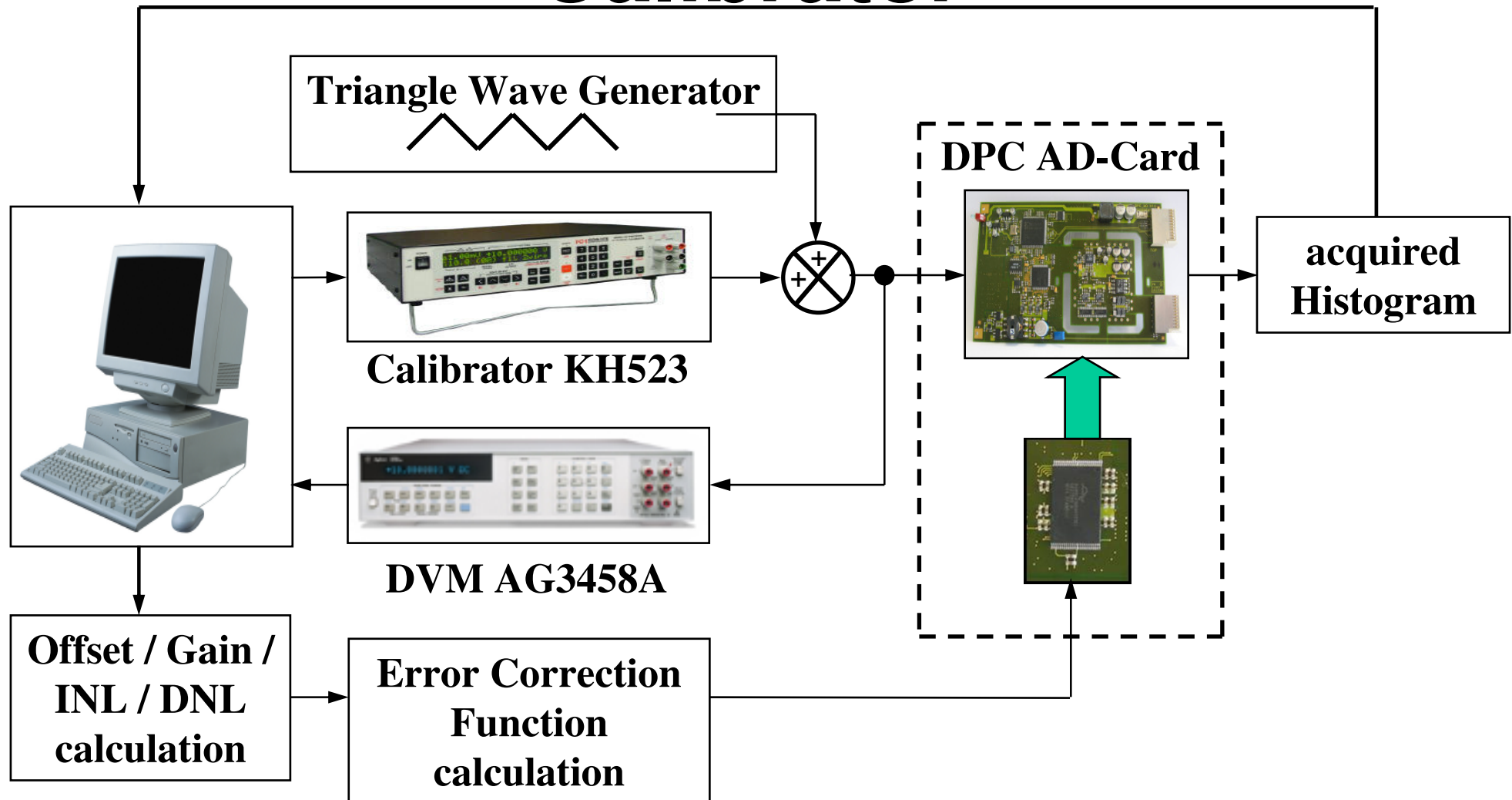


Controller

The Principle of the Histogram Method

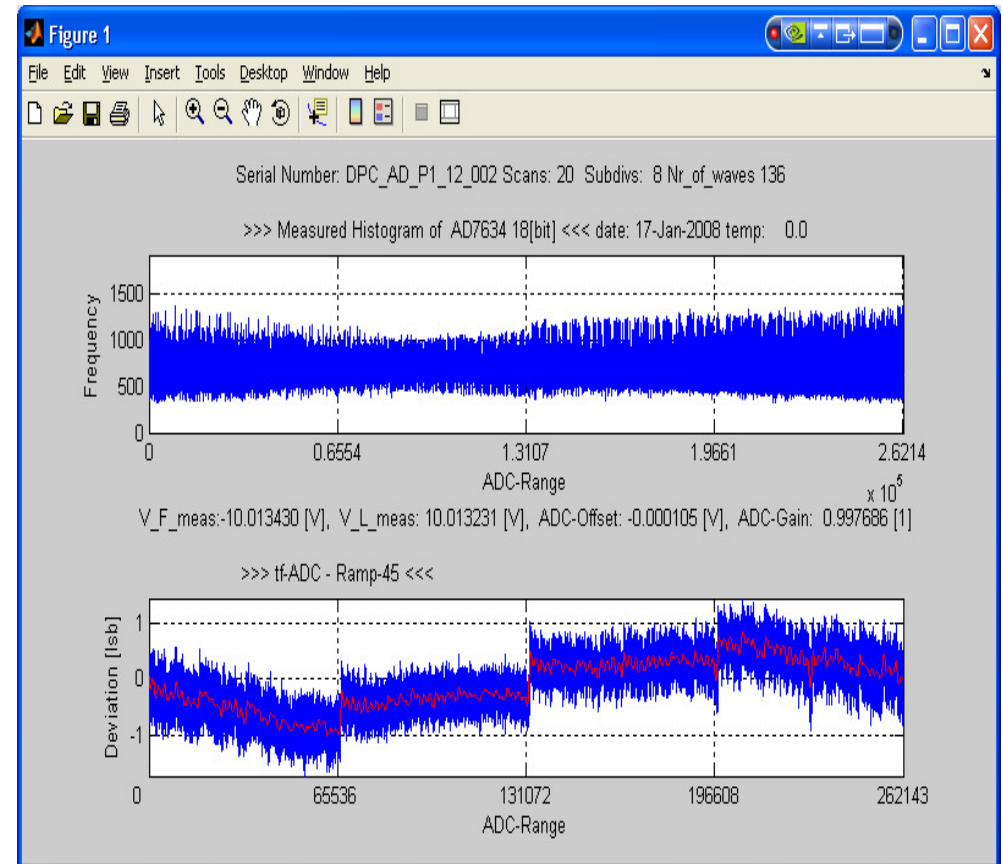
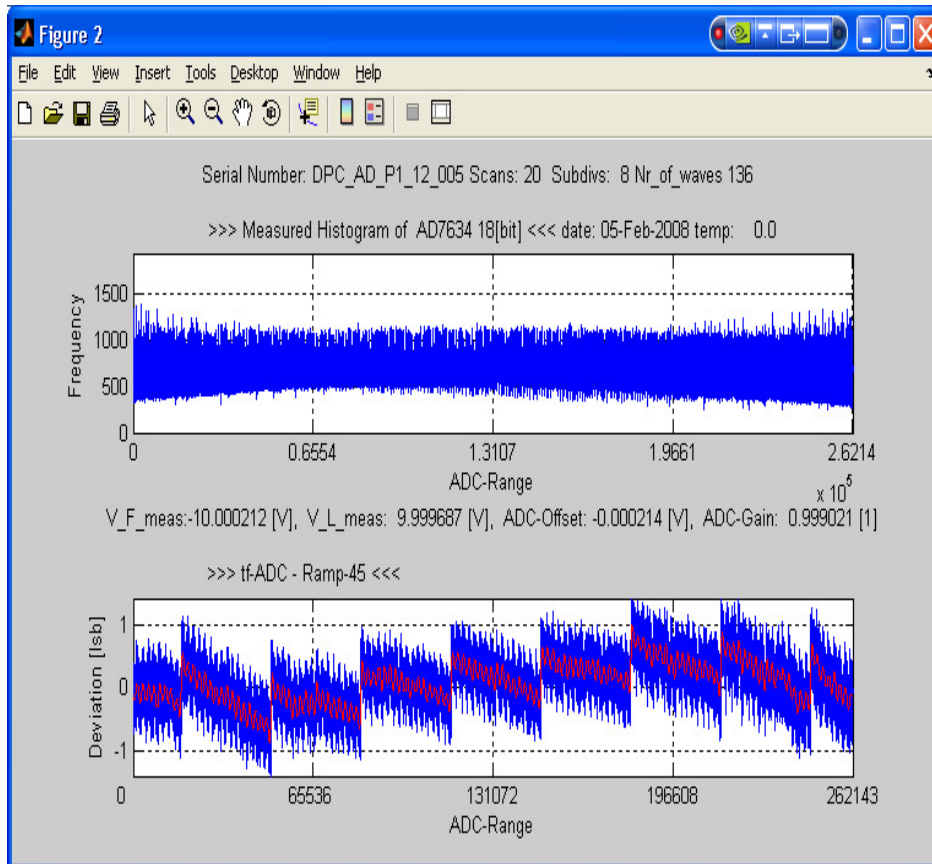


Topology of AD Analyzer and Calibrator



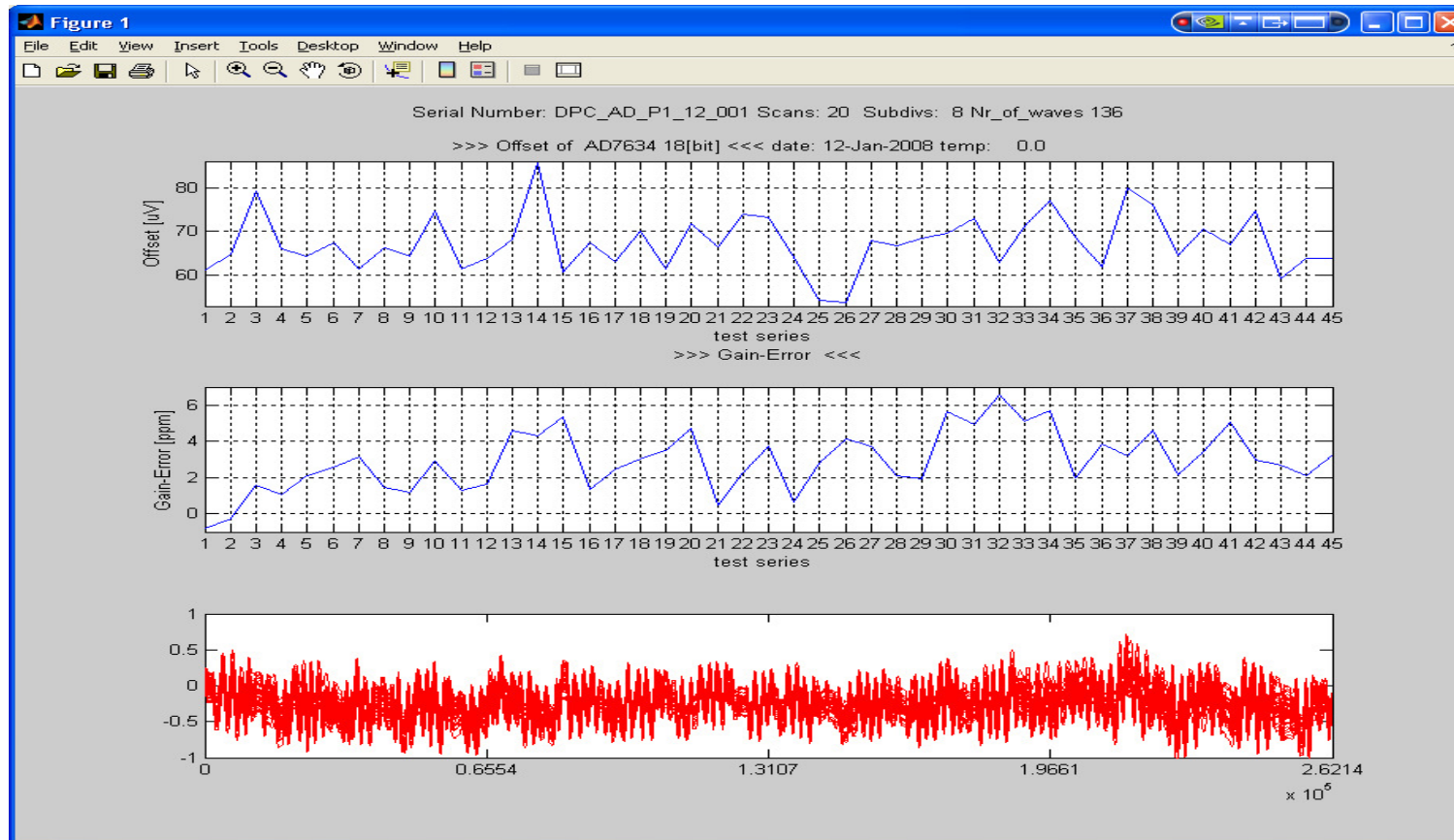
Examples of results I

ADC transfer function



Examples of results II

Reproducibility

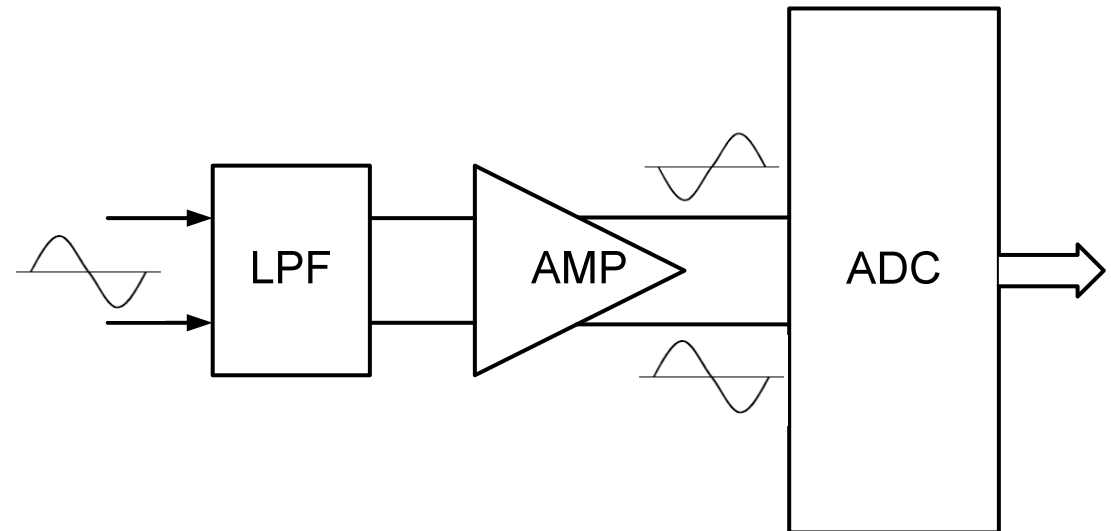


Design Considerations: ADC Input Stage

- High input voltage range
(+/-10V)

- Single ended or bipolar
input voltage range

- Fully differential signal path



Resolution, Sampling Rate

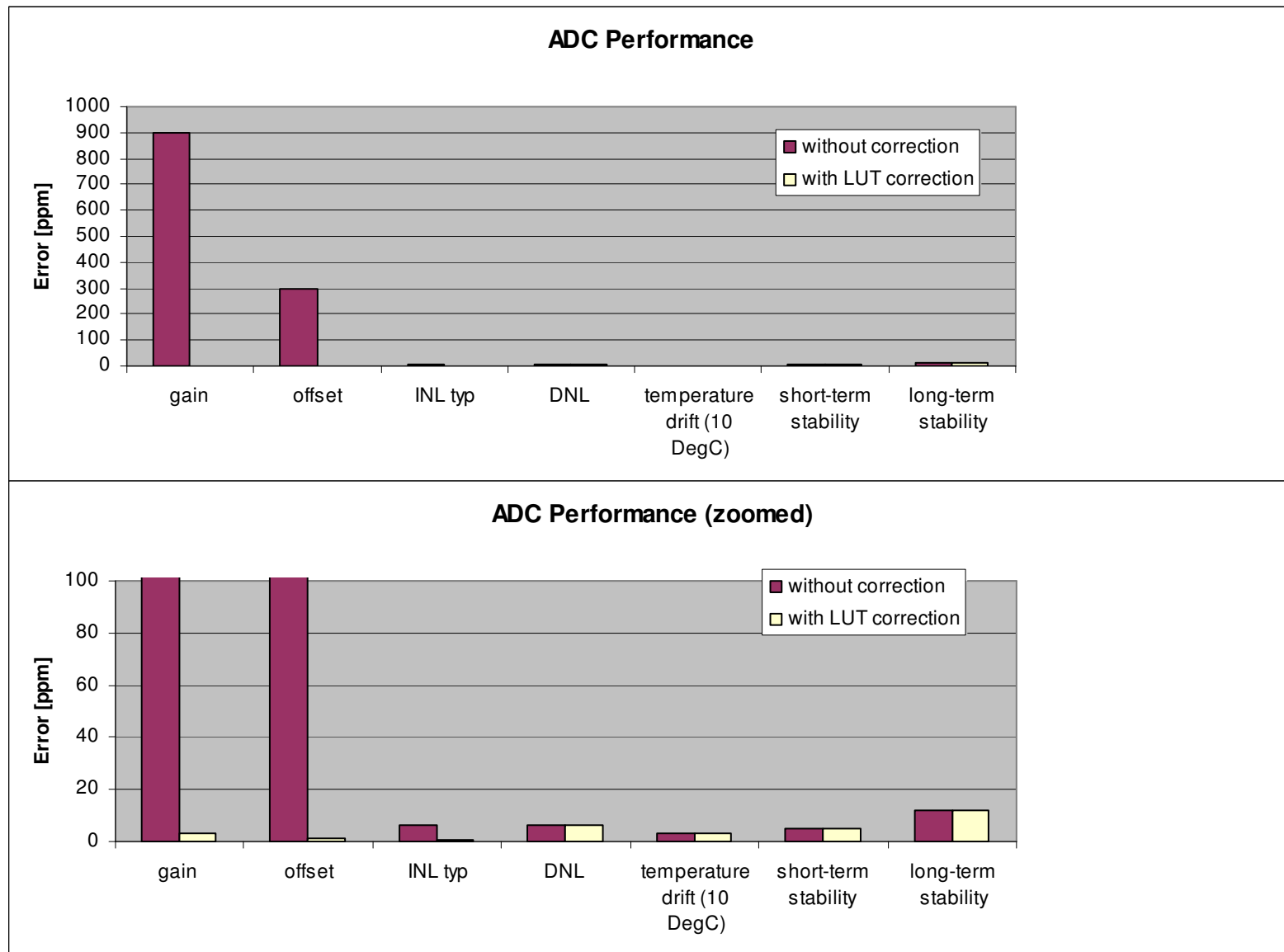
- High Resolution (≥ 18 bit)
 - quantisation step decreased
- Higher sampling rate
 - improved resolution by oversampling

Comparison of ADC Types

SAR \leftrightarrow $\Sigma\Delta$

Criteria	SAR	$\Sigma\Delta$
Resolution	+	++
Linearity	-	+
Offset	+	-
Gain	+	-
Group delay	++	-
AC-Performance	+	+

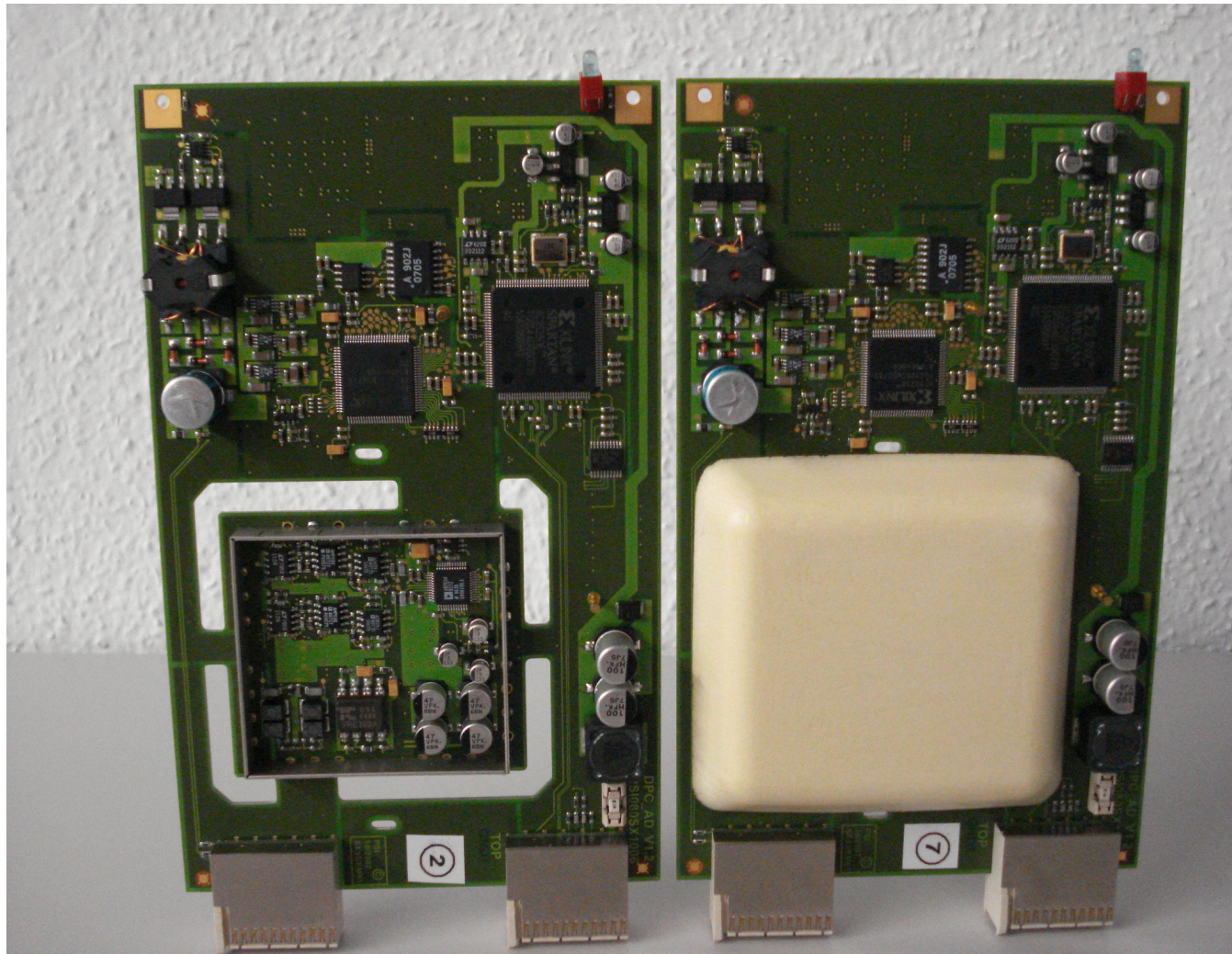
DC- Performance



Corrections

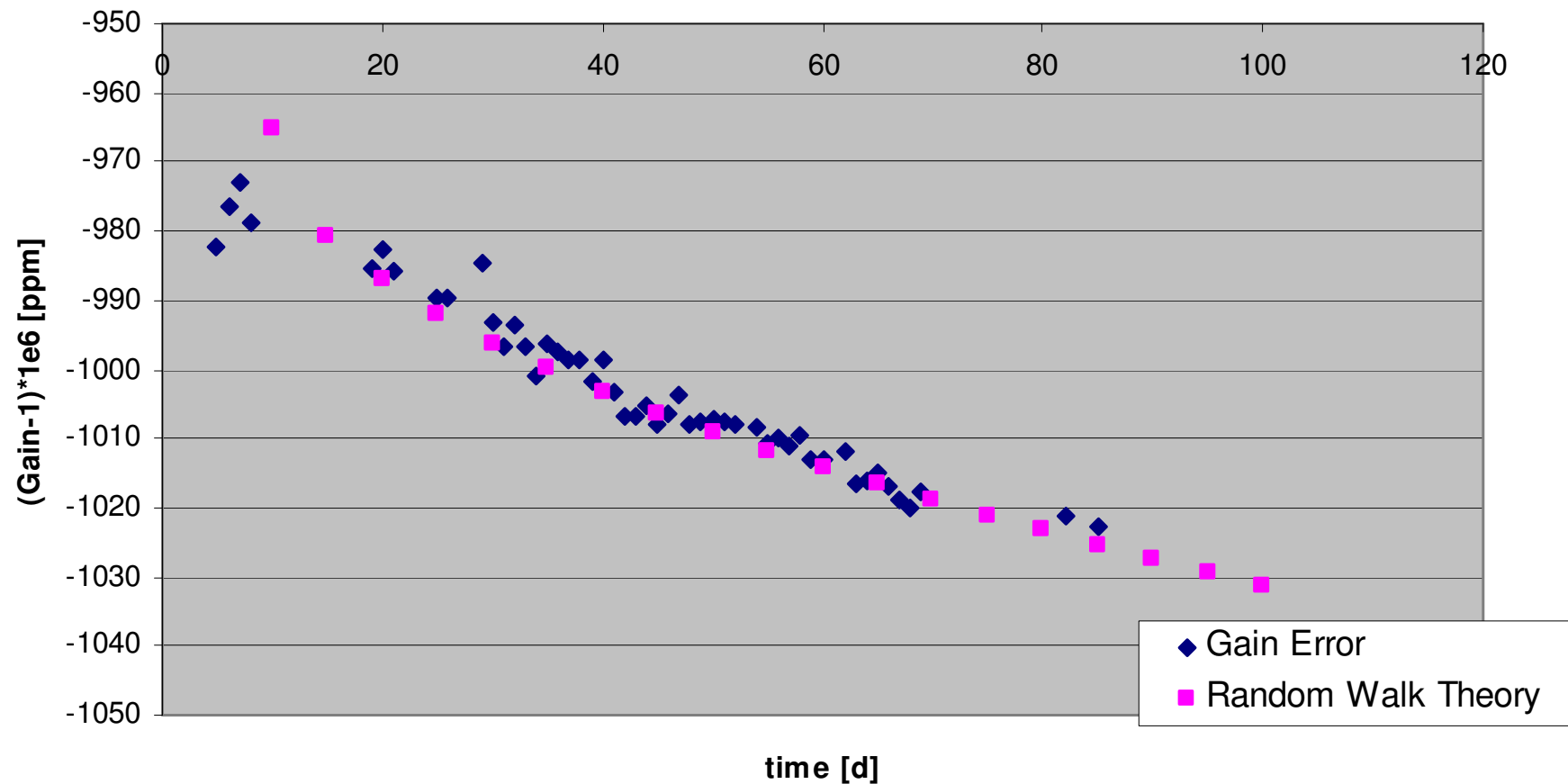
Error	Correction
Gain, Offset, INL	LUT correction
DNL	Oversampling and averaging, dithering
AC characteristic	Oversampling and averaging, dithering

Temperature Stabilization



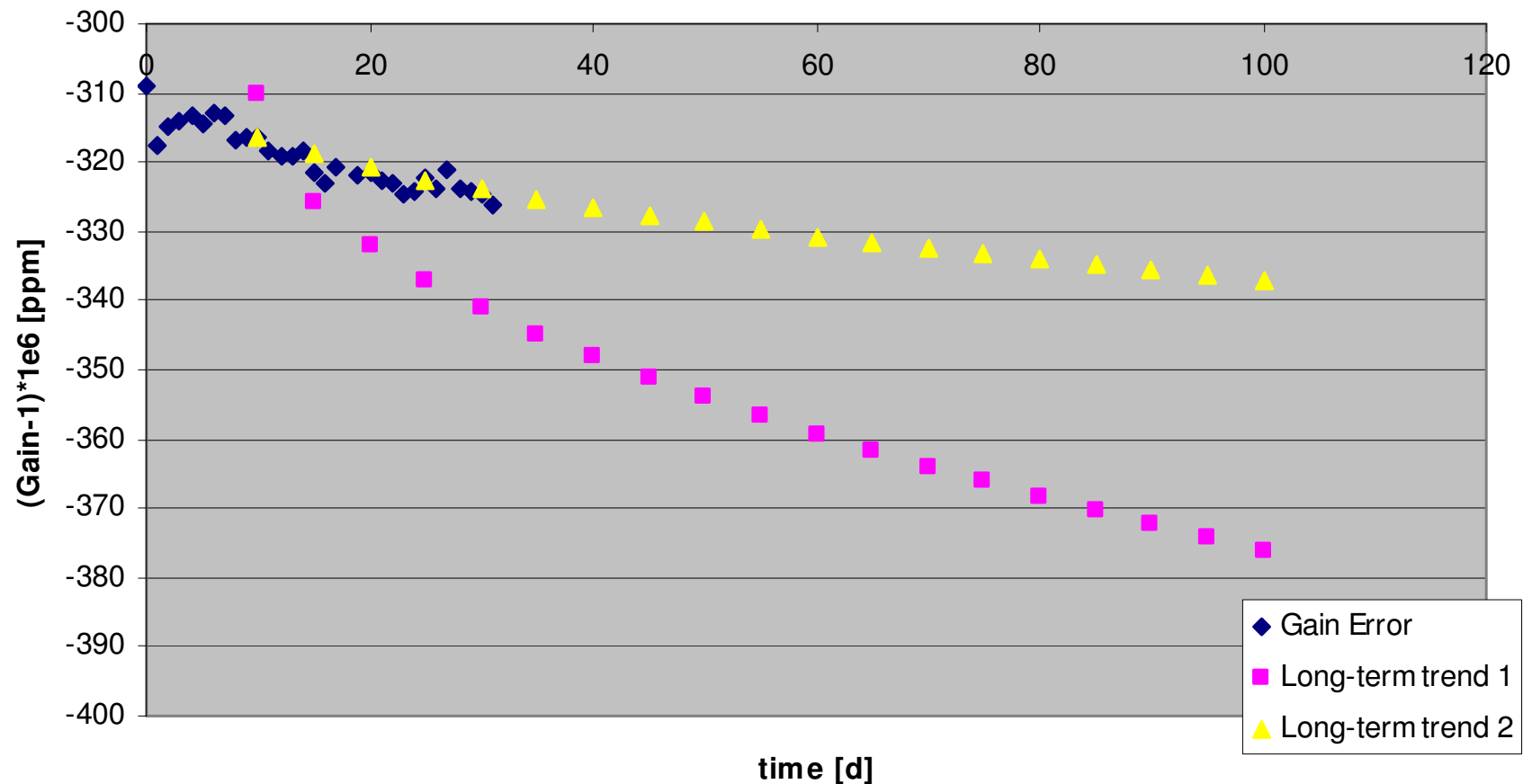
Long-term Stability

Long-term Stability of Gain (uncorrected)
DPC_AD_P1_12_005

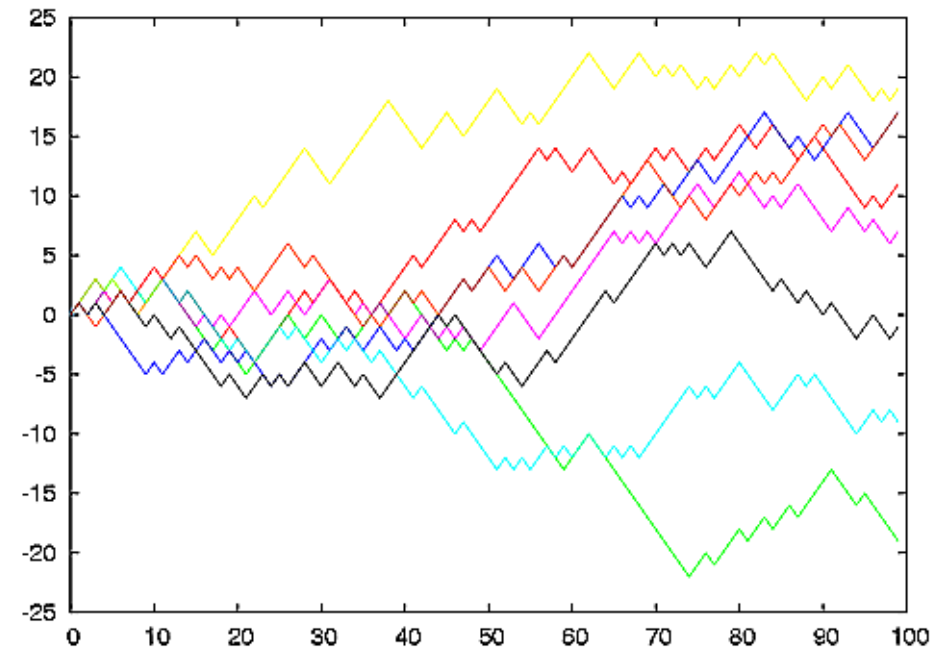
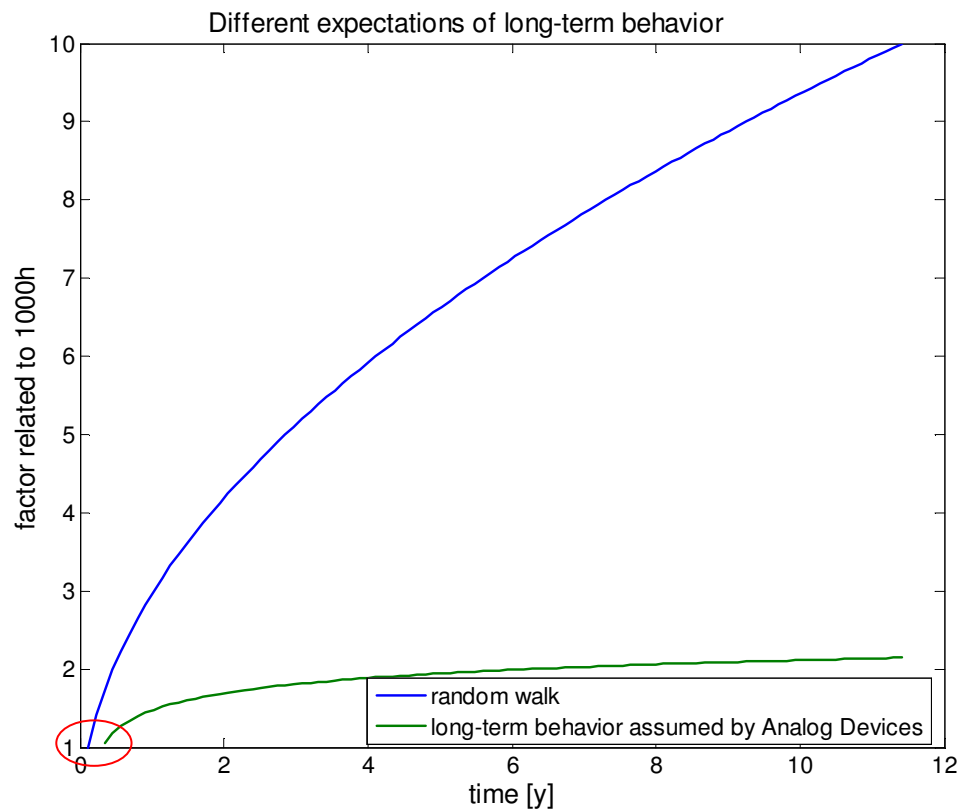


Long-term Stability

Long-term Stability of Gain (uncorrected)
DPC_AD_P1_12_010



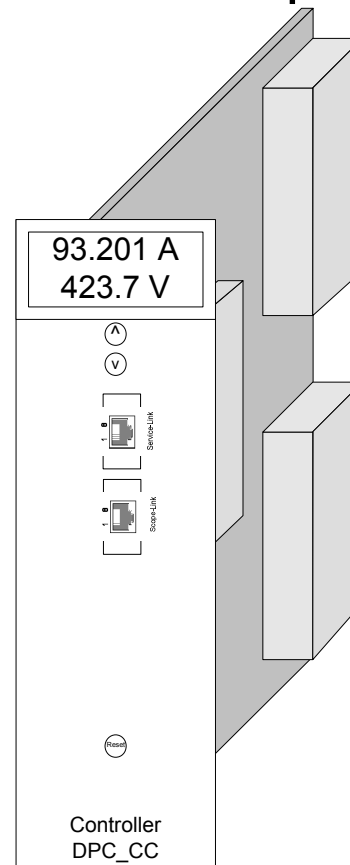
Theory of Long-term Stability

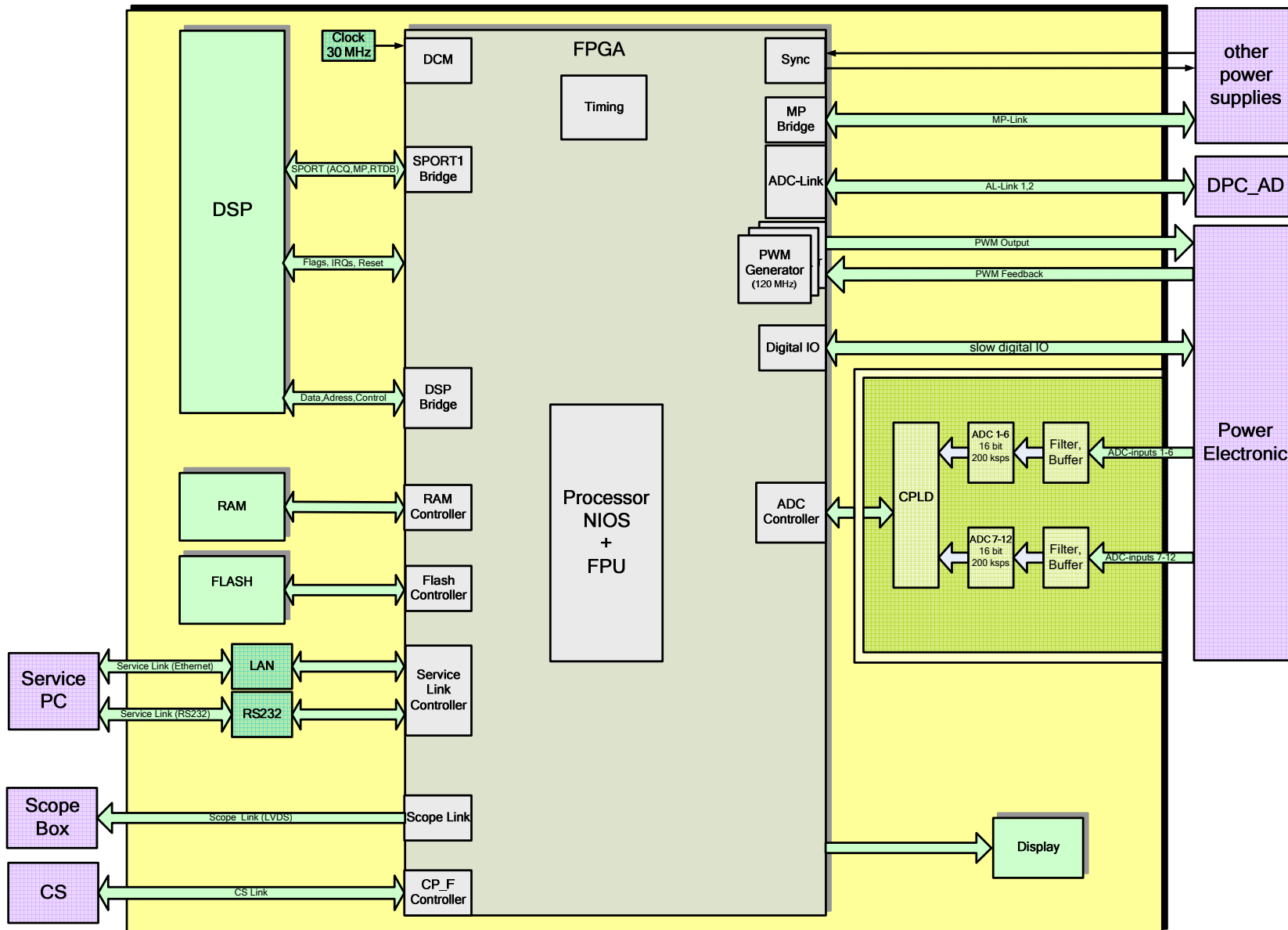


Sub-Project II

New Controller Board

under development

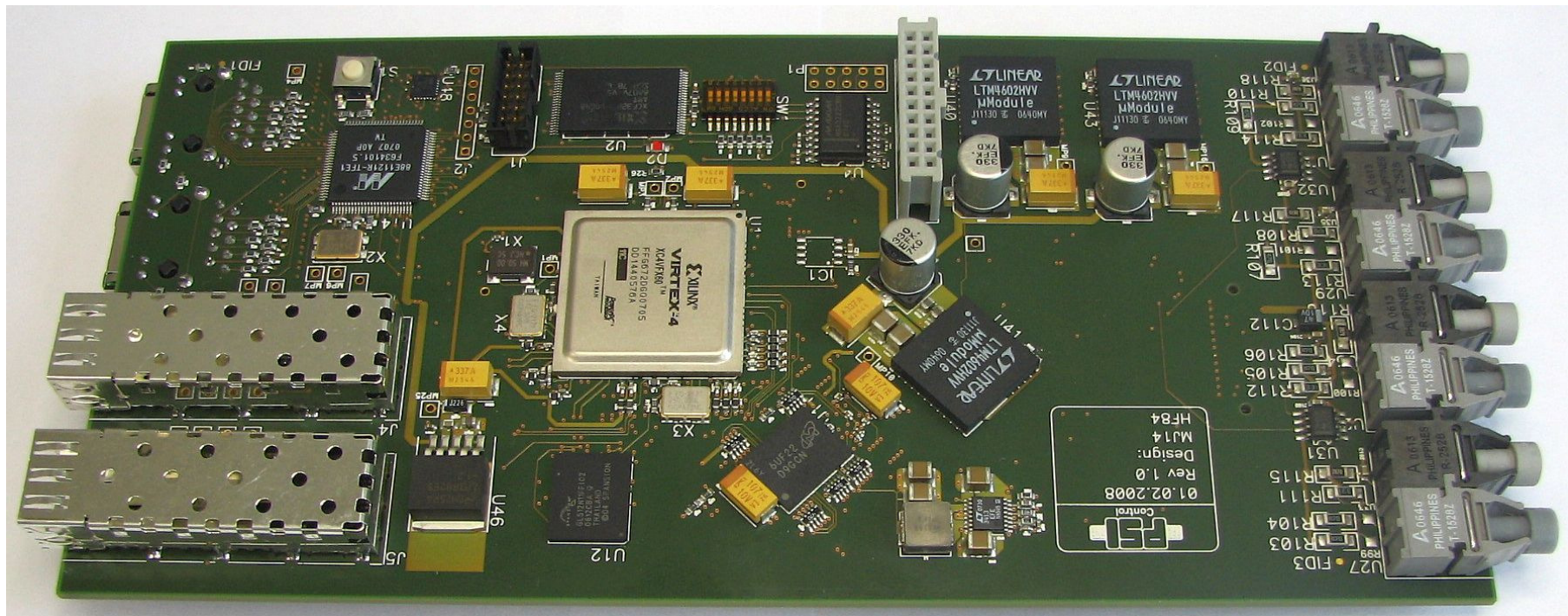




Sub-Project III

Data-Concentrator

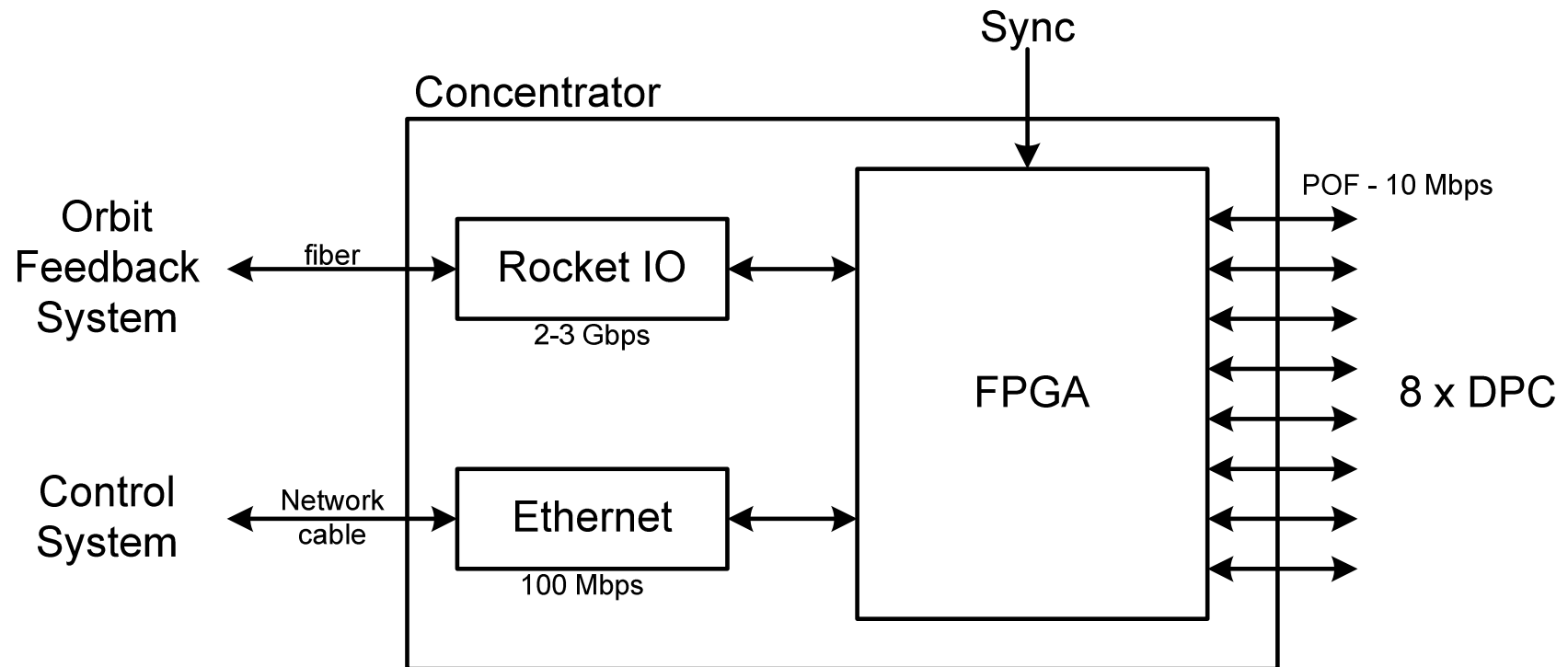
designed by Guido Janser et al.

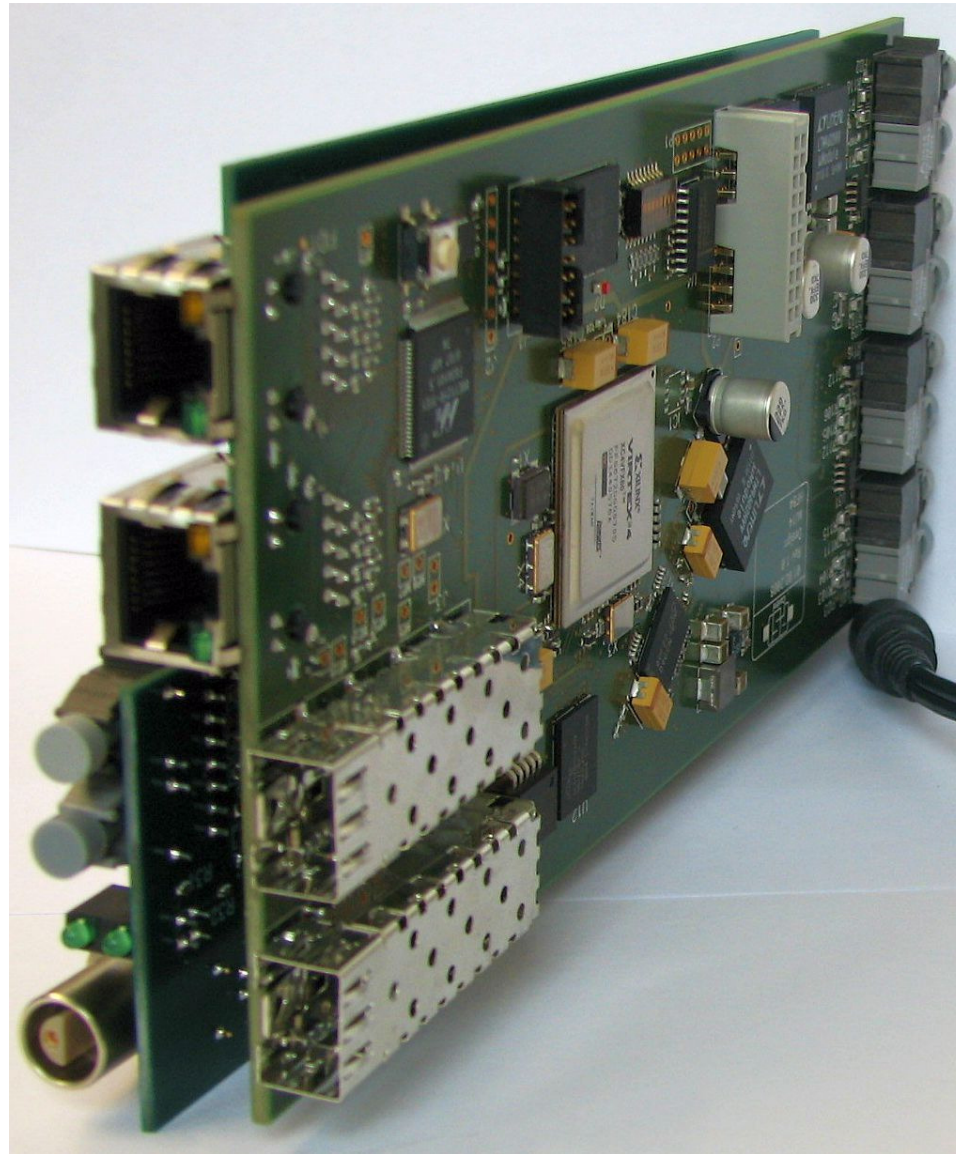


Data Concentrator

- Minimizes latency to orbit feedback system
- HW prepared for EPICS IOC
(PowerPC, VxWorks)
- Cost-saving solution

Control System: Data concentrator





Discussion/ Questions