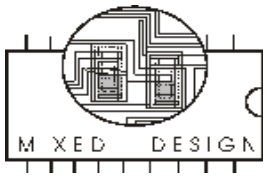
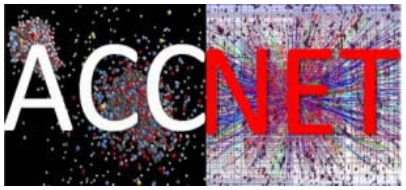
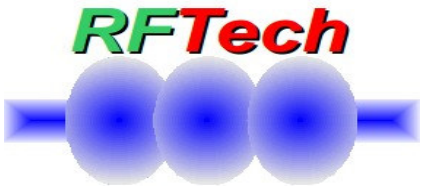




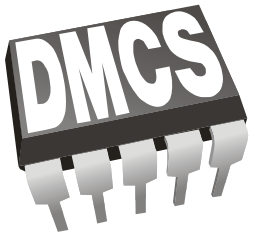


Power Supply Unit for ATCA – based Piezo Compensation System

The research leading to these results has received funding from the European Commission under the FP7 Research Infrastructures project EuCARD, grant agreement no. 227579.

Power Supply Unit for ATCA – based Piezo Compensation System

K. Przygoda



T. Poźniak, D. Makowski, T. Kozak, M. Wiśniewski, A. Napieralski
Department of Microelectronics and Computer Science
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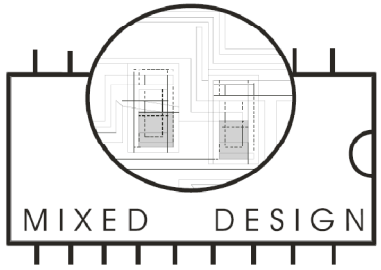
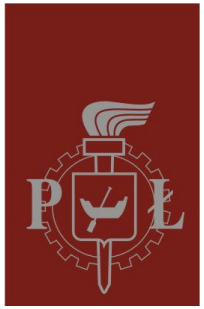


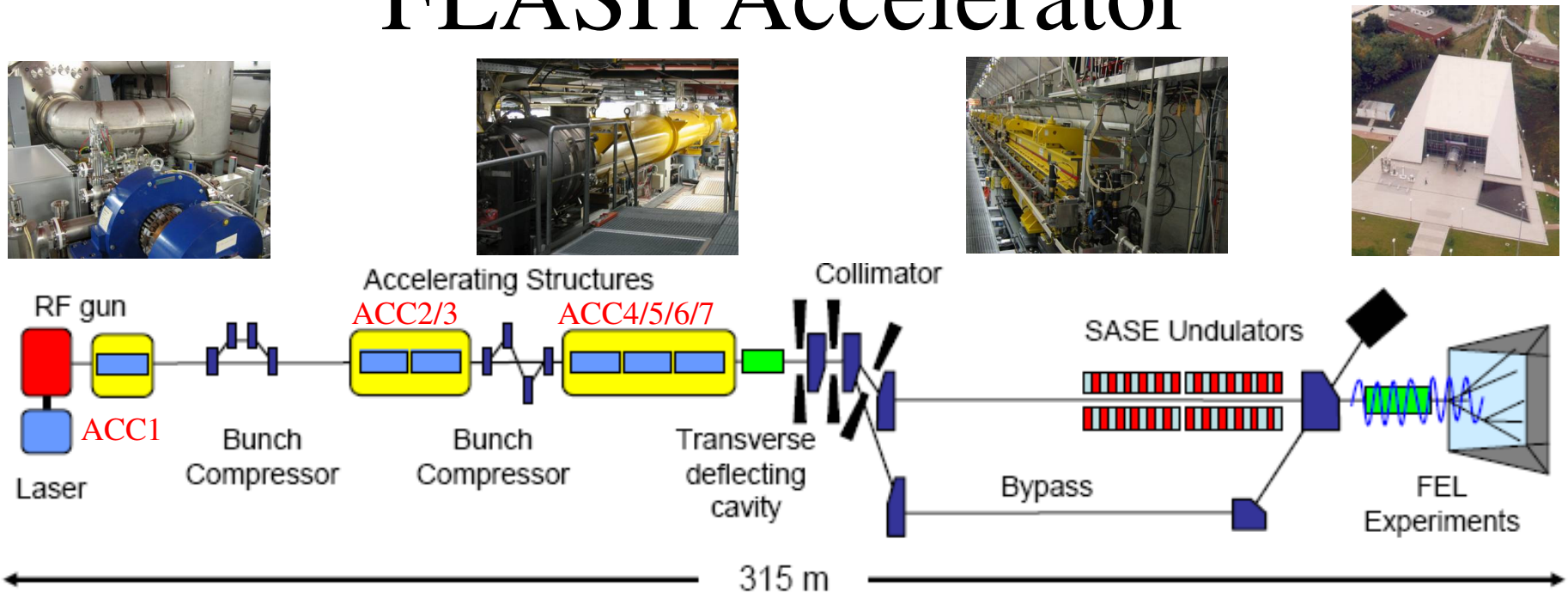
17th International Conference
Mixed Design of Integrated Circuits and Systems
Wrocław, 24-26 June 2010



Agenda

- Introduction
- Piezo compensation system at FLASH
- ATCA standard overview
- ATCA – based piezo compensation system
- Power supply unit prototype tests
- Summury and conclusions

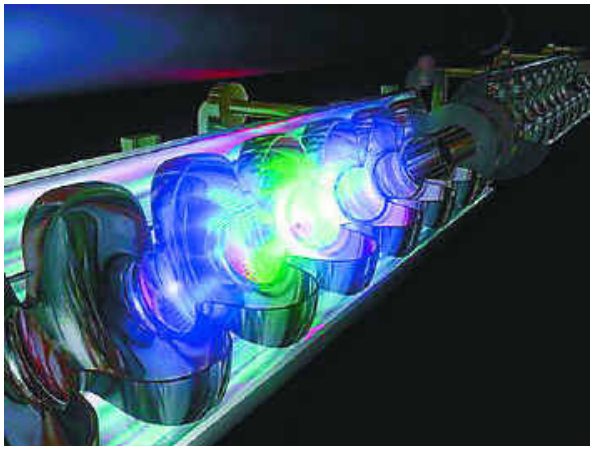
FLASH Accelerator

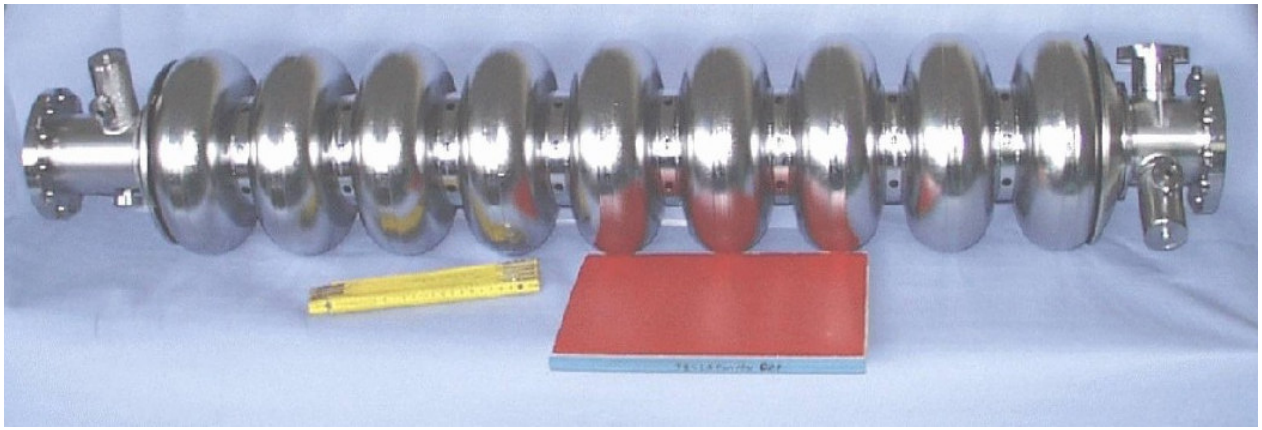


*Main parameters: (**F**ree Electron **LAS**er in **H**amburg):*

- length ~ 315 m,
- beam energy→ wavelength; E ≈ 1,2 GeV → $\lambda_e \approx (44 \div 6)$ nm,
- 4 RF stations: ACC1; ACC2/3; ACC4/5; ACC6/7,
- RF stations powered by 5 ÷ 10 MW klystrons,
- 7 accelerating modules composed of 8 superconducting cavities each,
- RF pulse duration of 1.3 ms, typical repetition rate f_{RP}= 10 Hz.

Supercondcuting Resonant Cavity

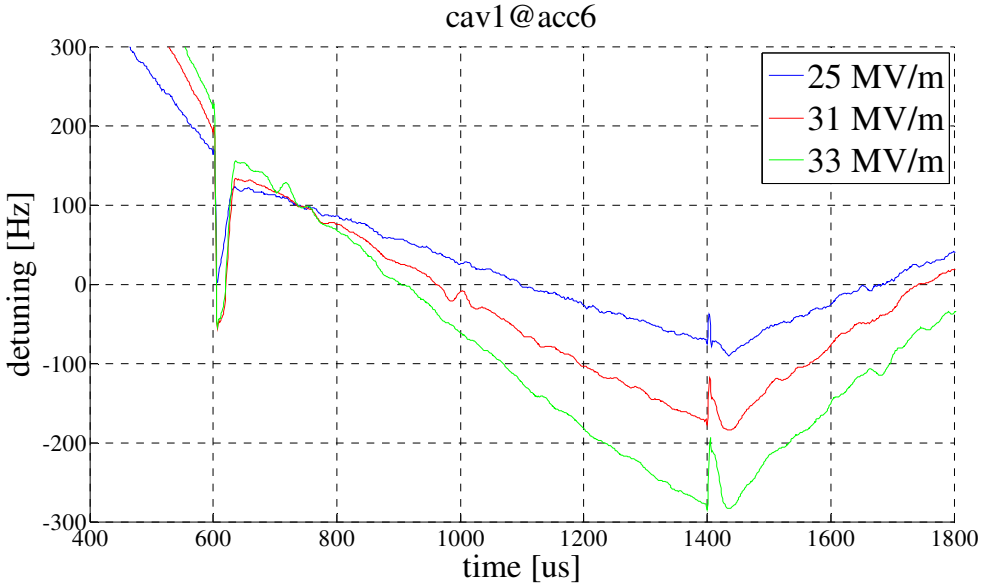


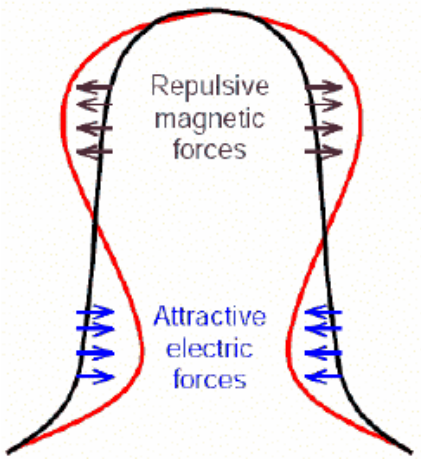


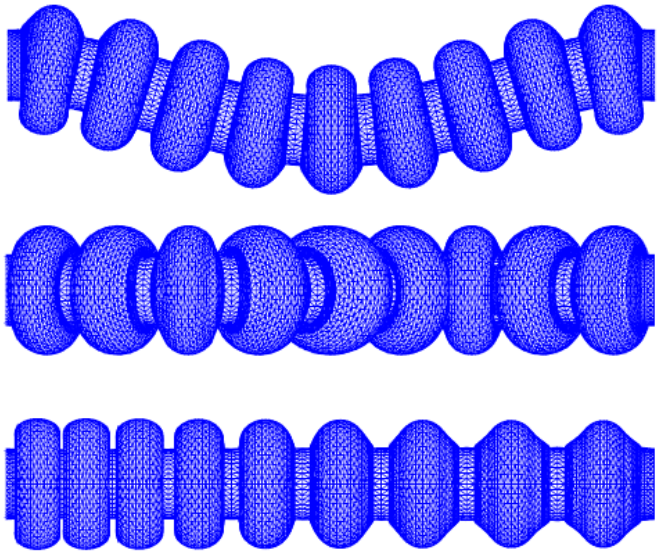
Main parameters:

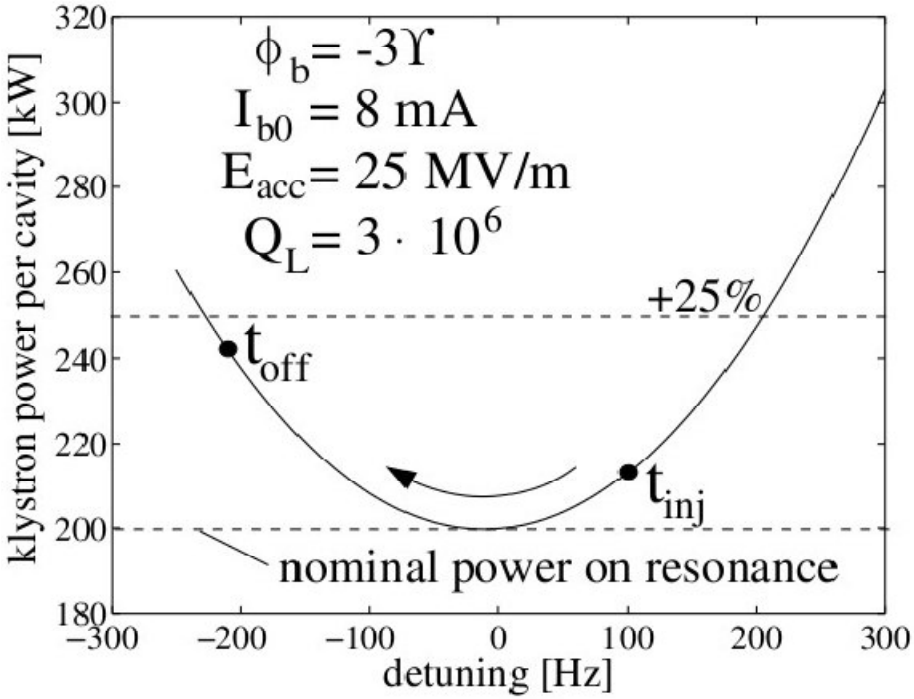
- TESLA technology,
- 1 m length, made of pure Niobium,
- resonance frequency $f_o \approx 1{,}3$ GHz,
- mechanical resonance frequency $f_m \approx 200 \div 300$ Hz,
- loaded qaulity factor $Q_L \approx 3 \cdot 10^6$,
- typical accelerating field gradient 25 MV/m.

Lorentz Force Detuning

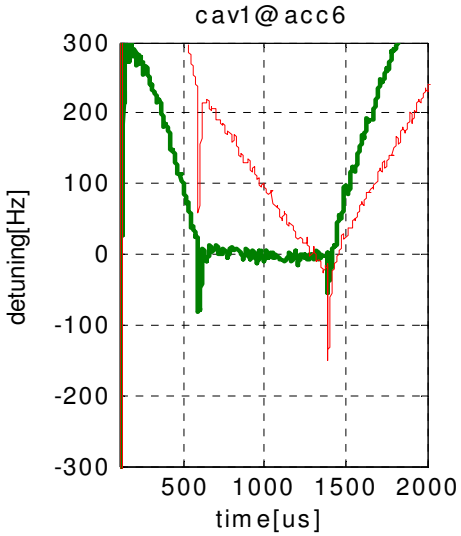


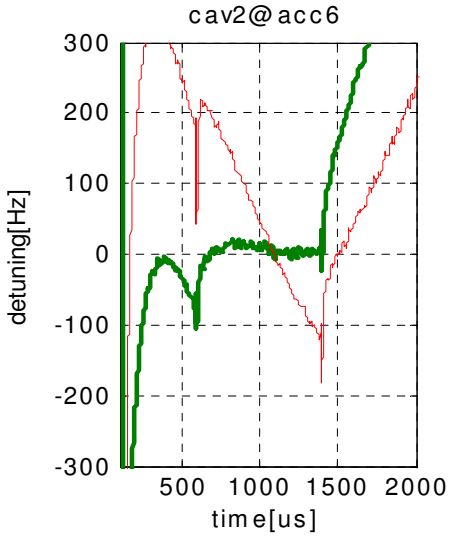


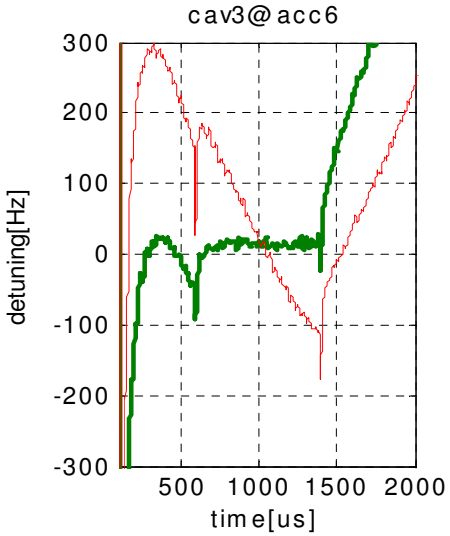


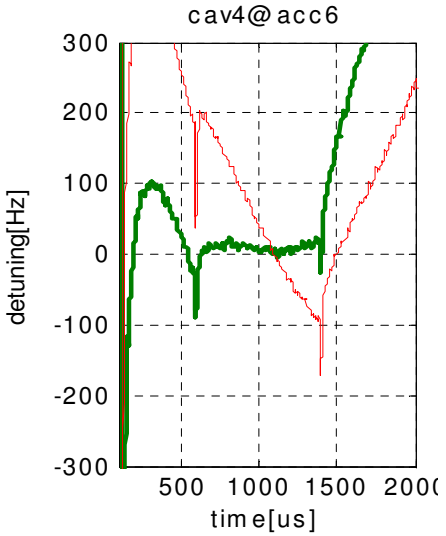


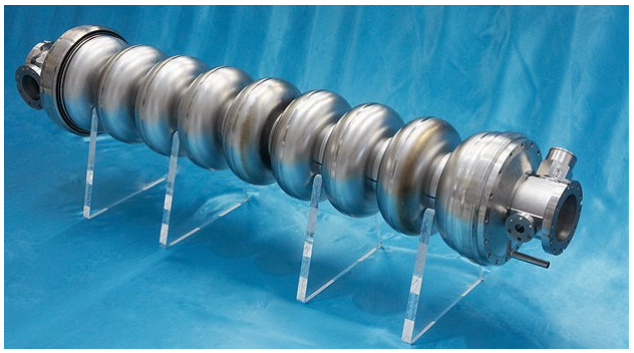
Compensation with Piezo Tuners

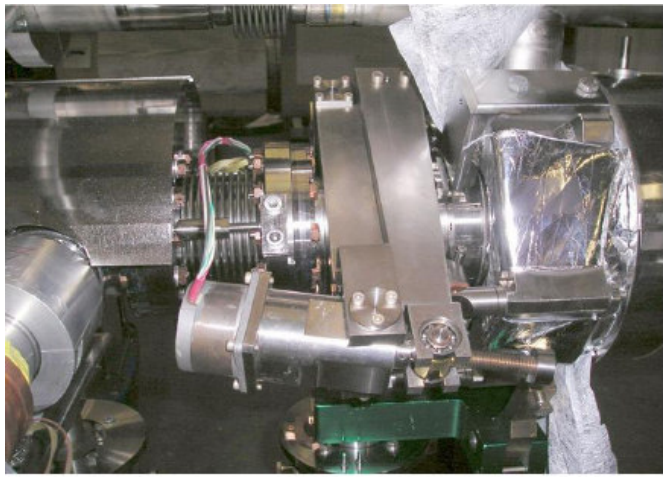


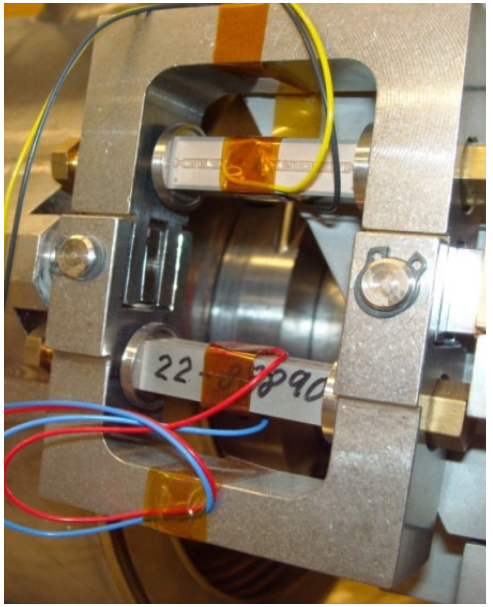




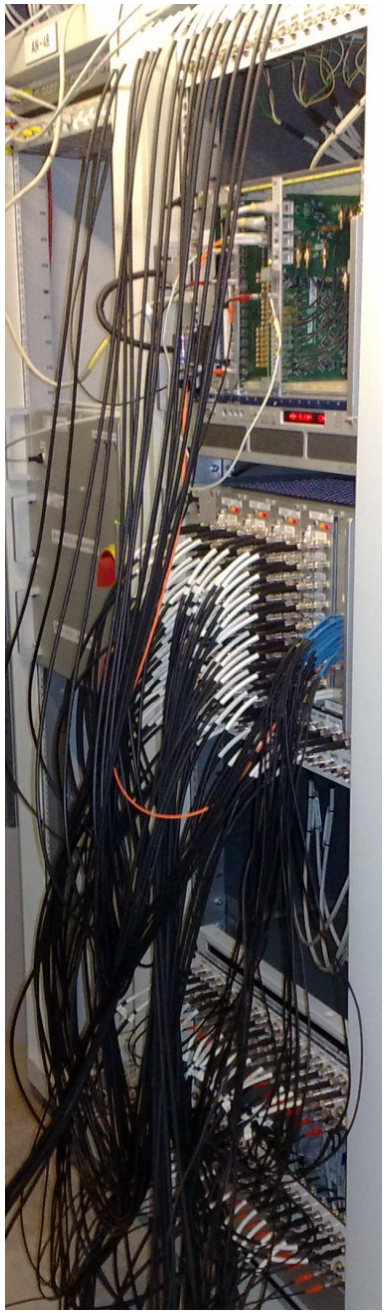


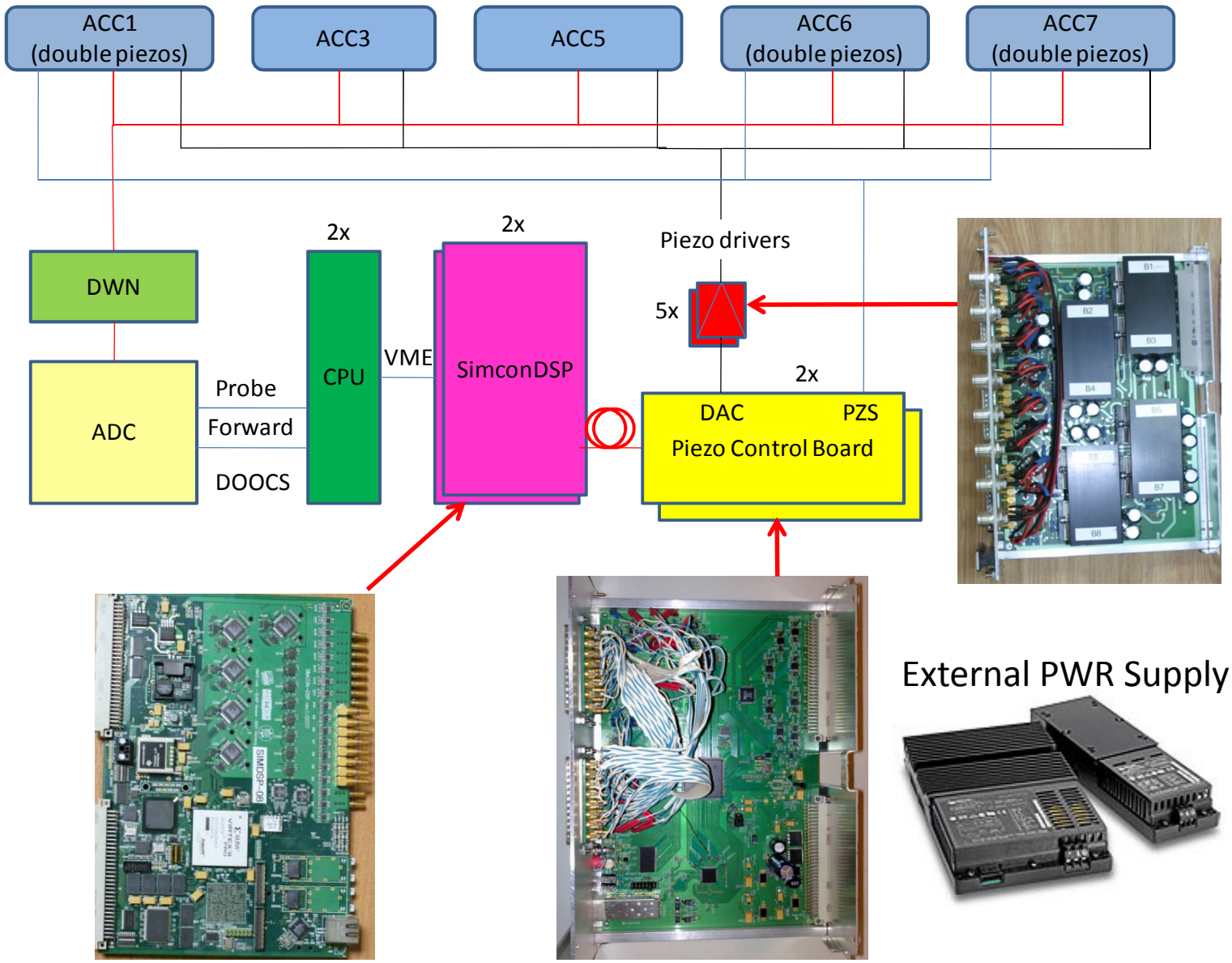




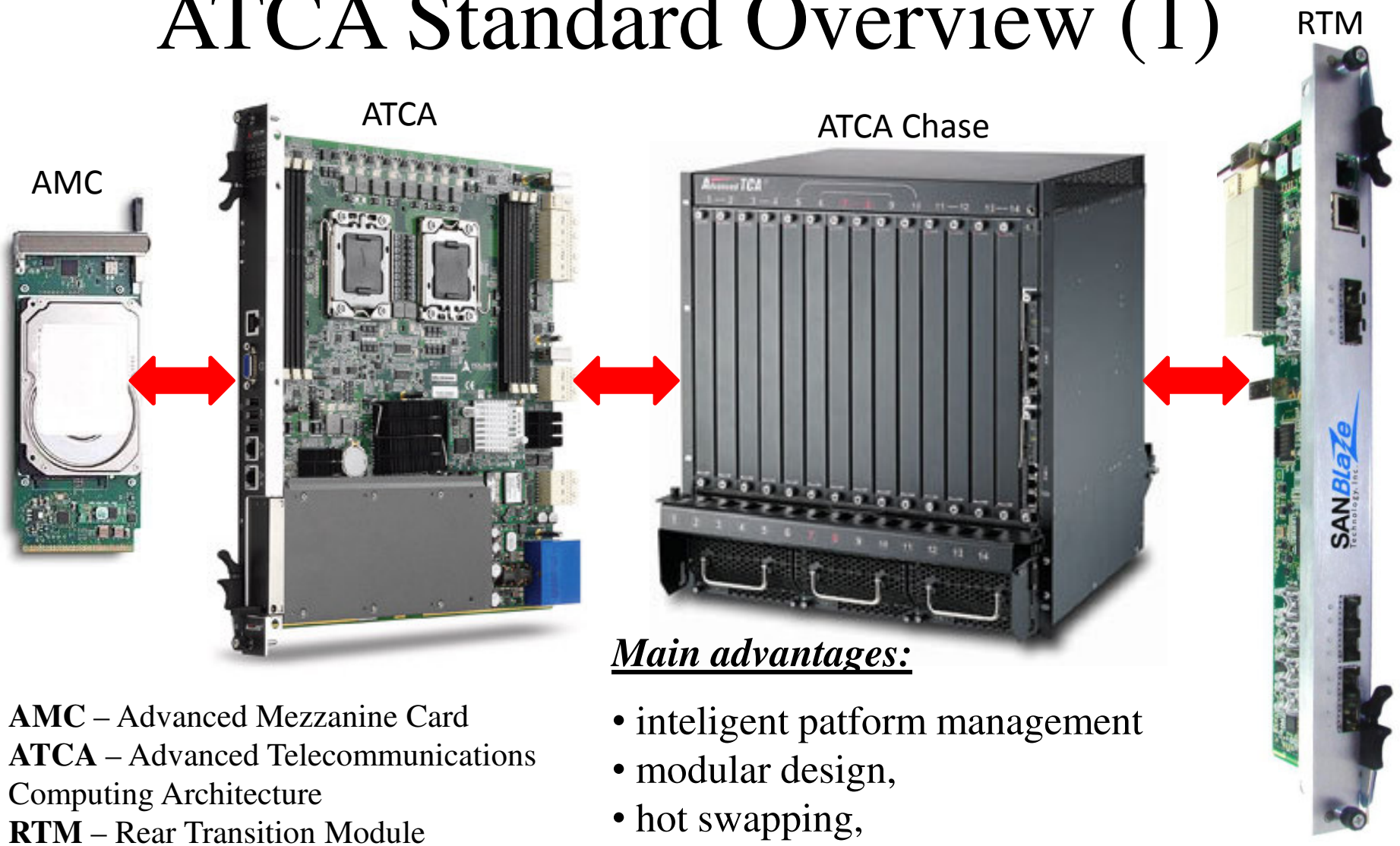


Piezo Compensation System at FLASH





ATCA Standard Overview (1)

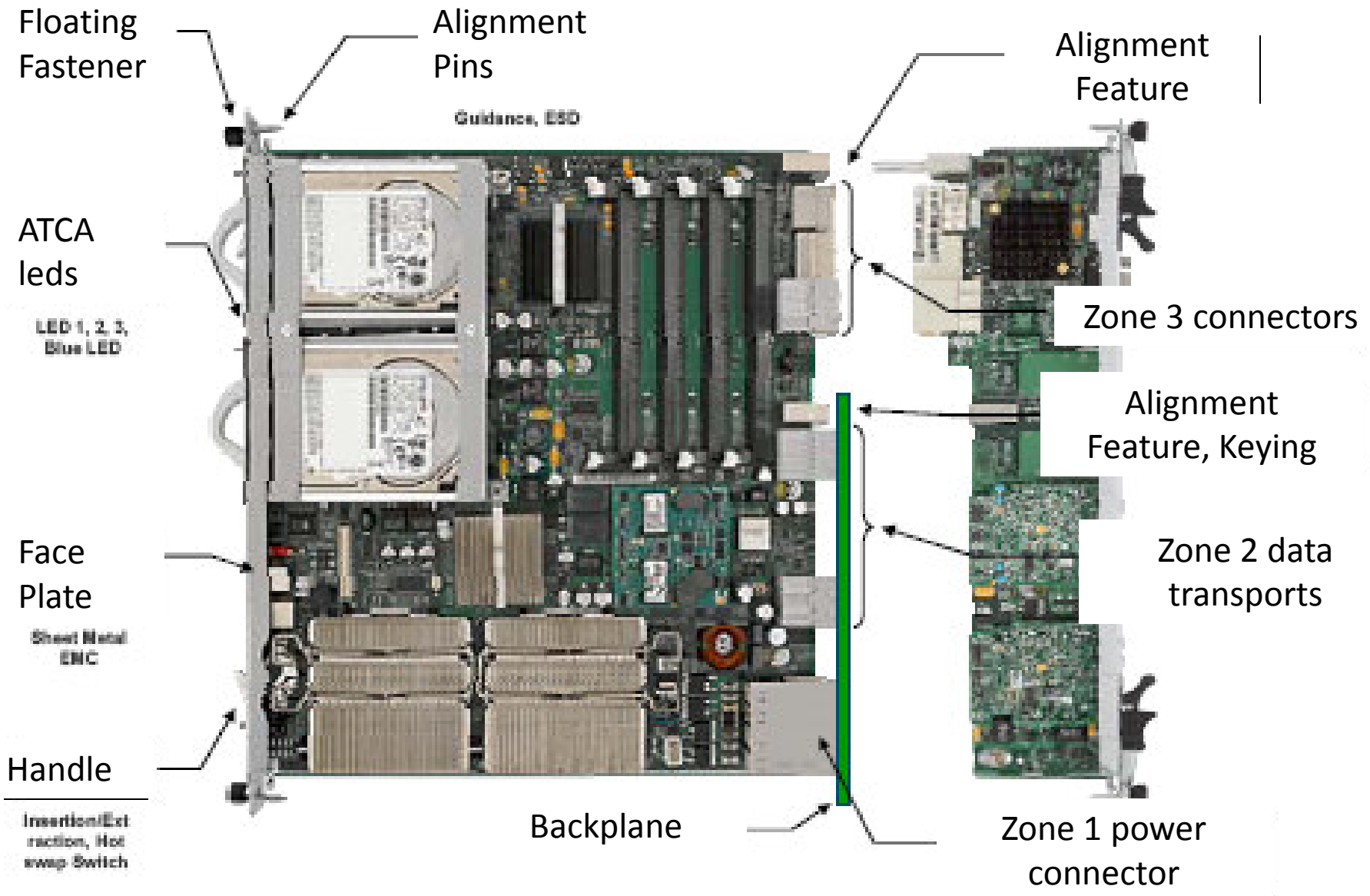


AMC – Advanced Mezzanine Card
ATCA – Advanced Telecommunications Computing Architecture
RTM – Rear Transition Module

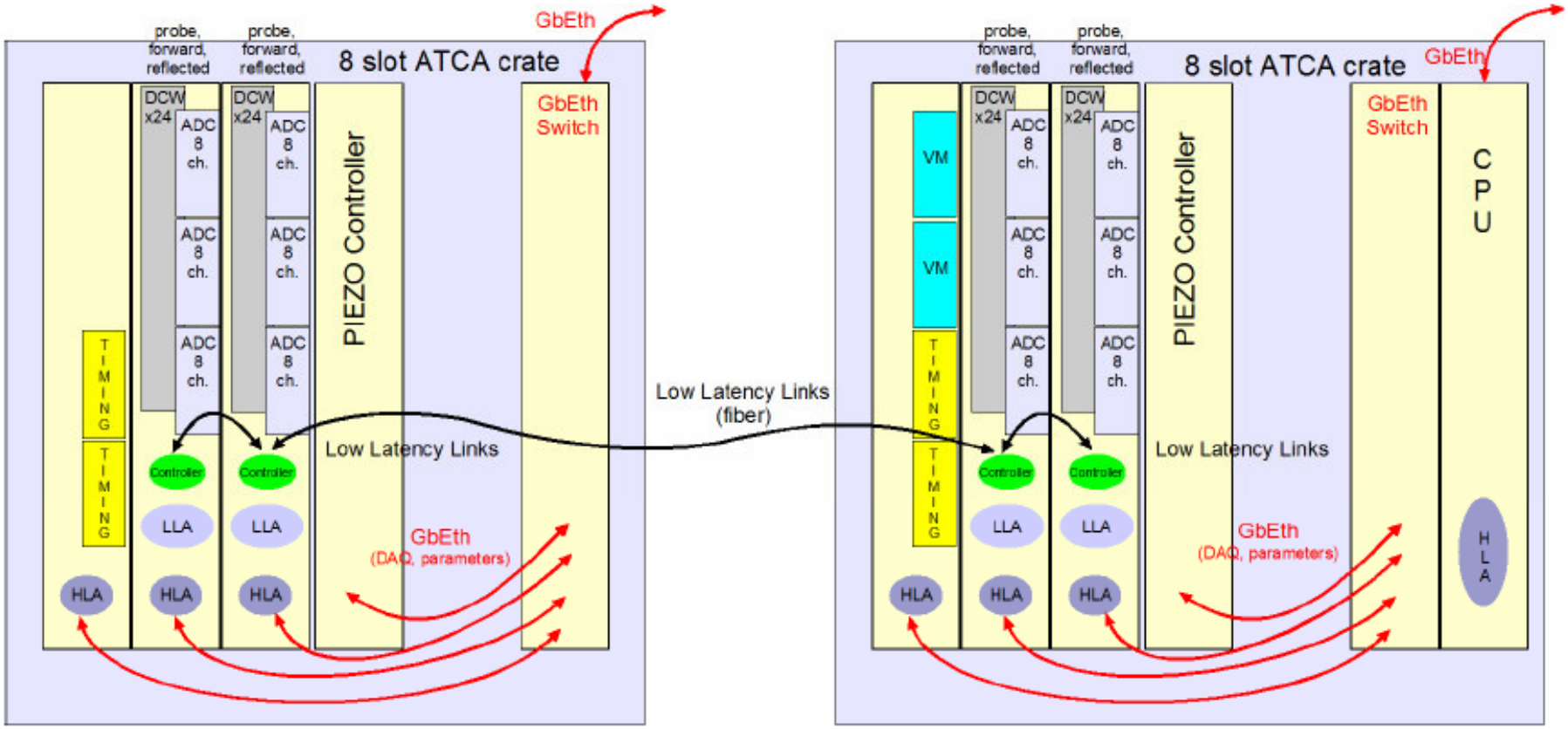
Main advantages:

- inteligent patform management
- modular design,
- hot swapping,
- redundancy for the most crucial circuits,
- single relatively high voltage power bus,
- backplane connections.

ATCA Standard Overview (2)



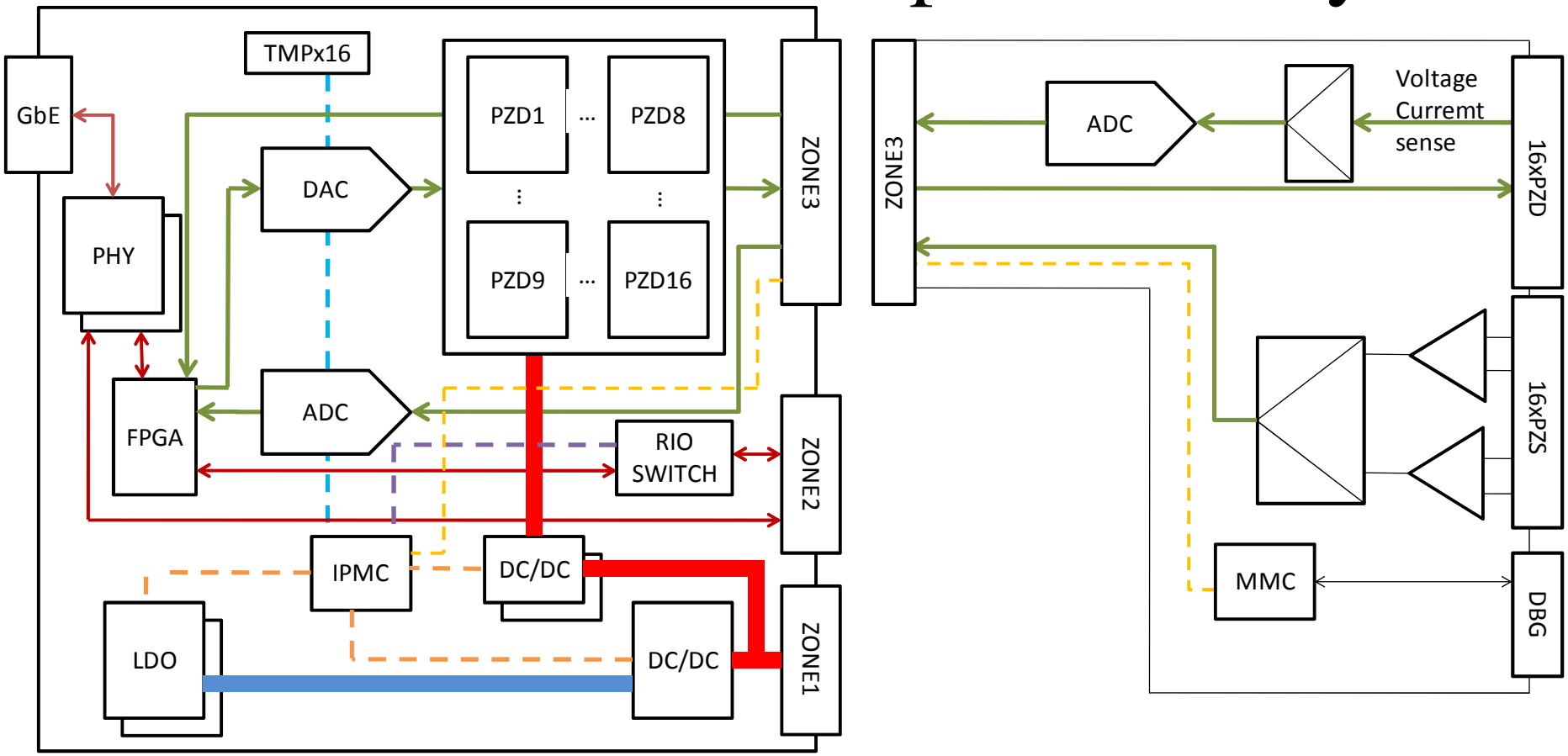
ATCA-based LLRF Control System



Piezo Controller configuration for ATCA LLRF:

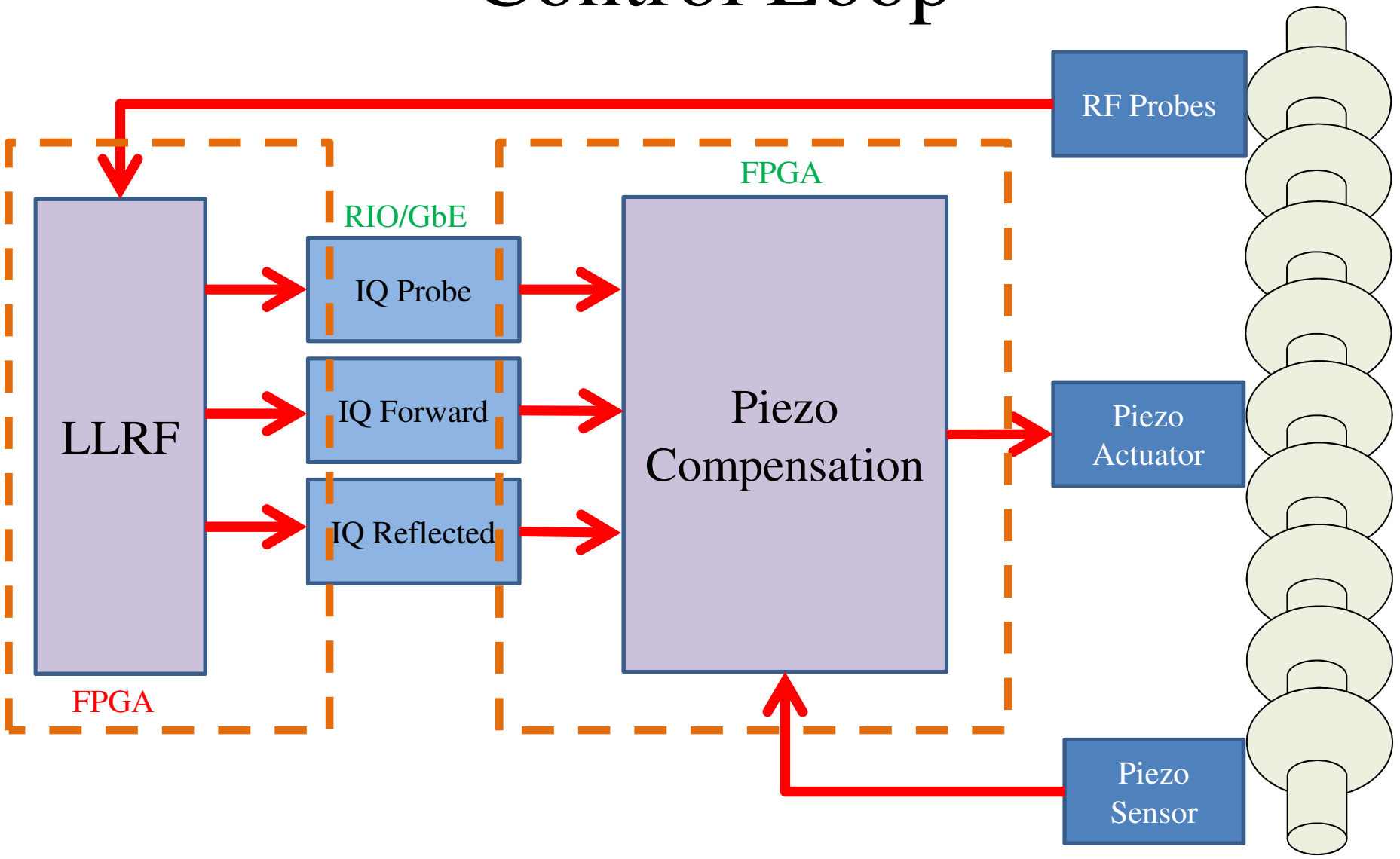
- 8 slots crate (can take for fabric interfaces slots 5÷8),
- 14 slots crate (can take for fabric interfaces slots 5÷14),

ATCA-based Piezo Compensation System

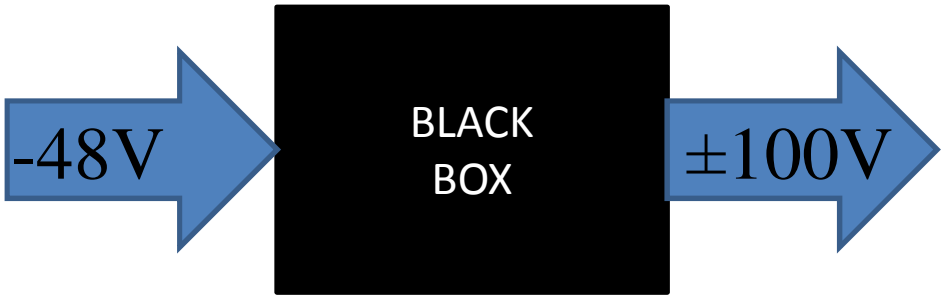


IPMB-0 – redundant I²C bus between Shelf Manager and IPMC on ATCA Carrier board
IPMB-L– local I²C bus between IPMC on ATCA Carrier board and external modules, i. e. RTM
IPMC – Intelligent Platform Management Controller
MMC – Module Management Controller

Control Loop

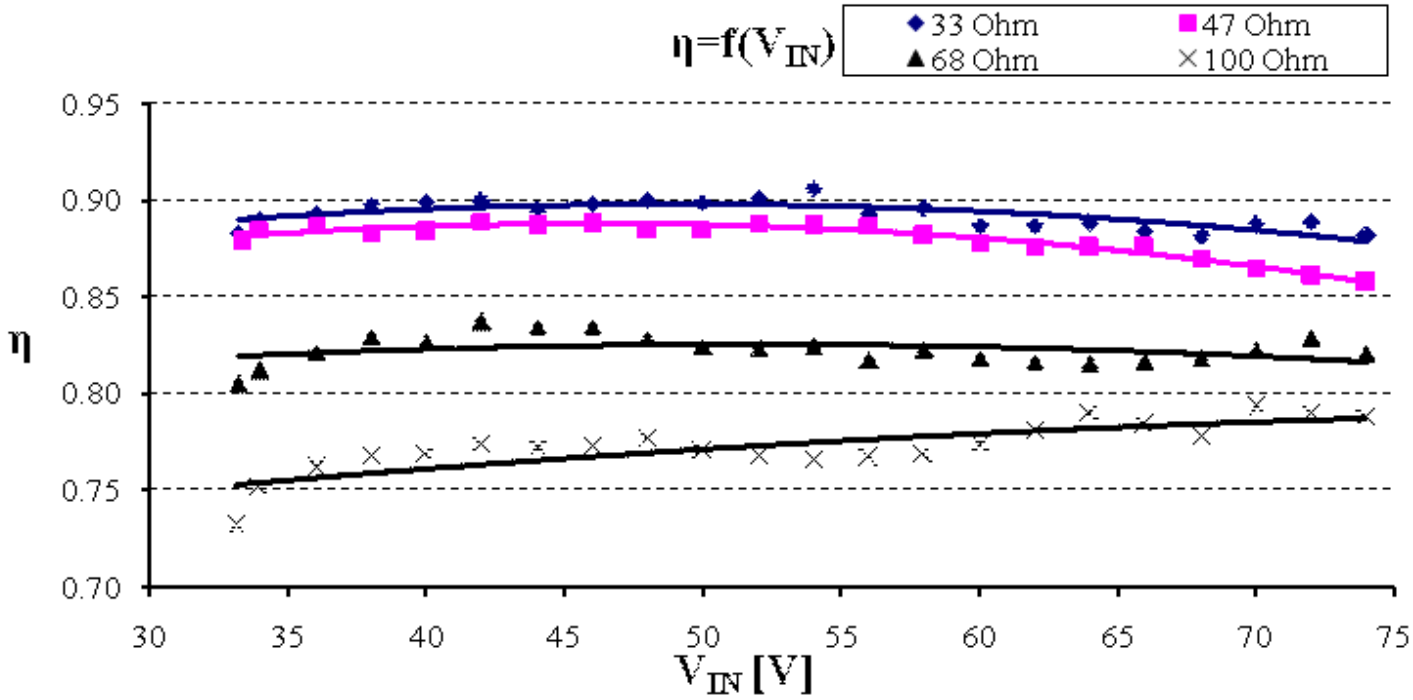


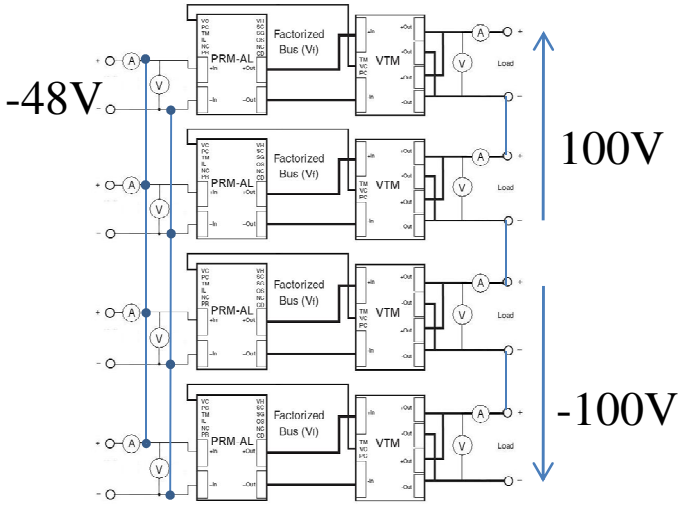
Prototype Power Supply Unit

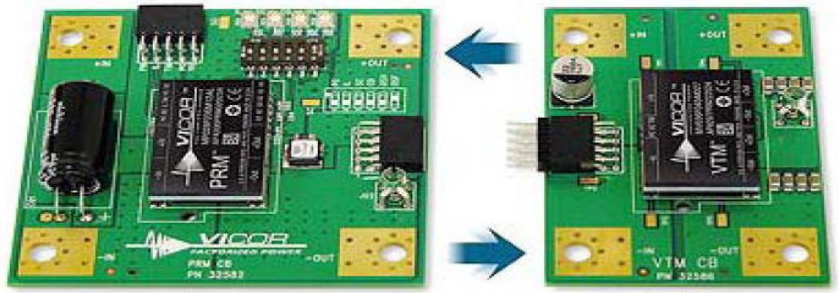


Parameter	PRM P048F048T24AL	VTM V048F480T006	BCM B048F48T30
V_{in} [V]	48 (36÷75)	48 (26÷55)	48 (38÷55)
V_{out} [V]	48 (26÷55)	48 (26÷55)	48 (38÷55)
P_{out} [W]	240	336	300
efficiency [%]	96	96	>96

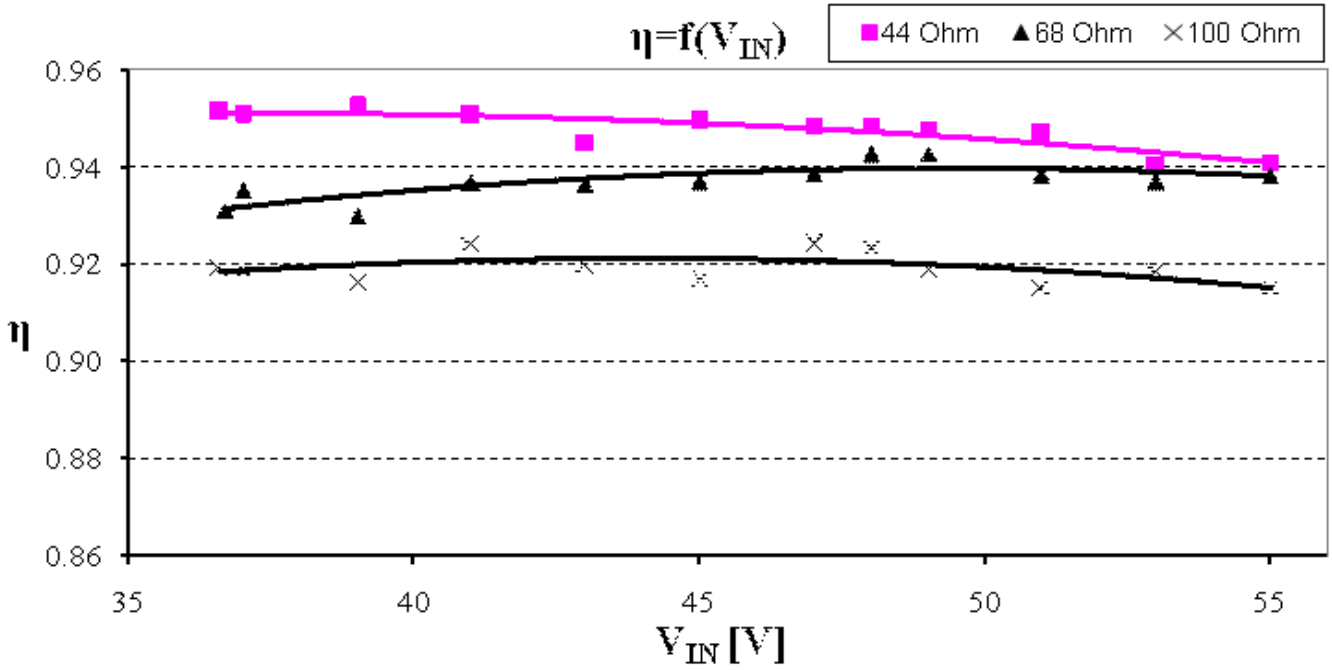
PRM-VTM Tests

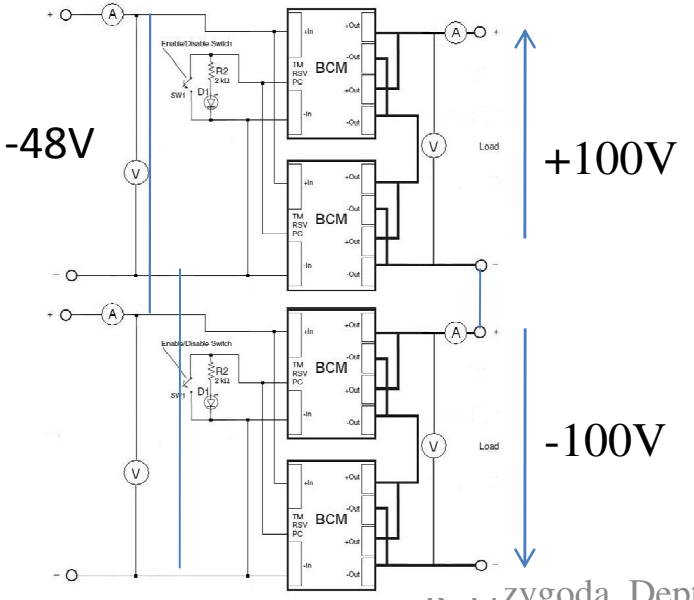


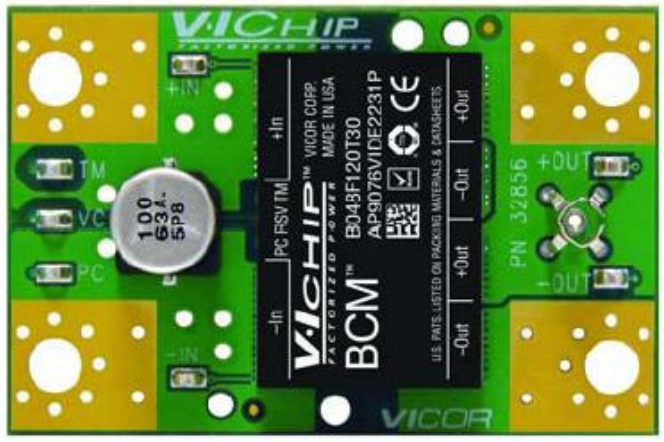




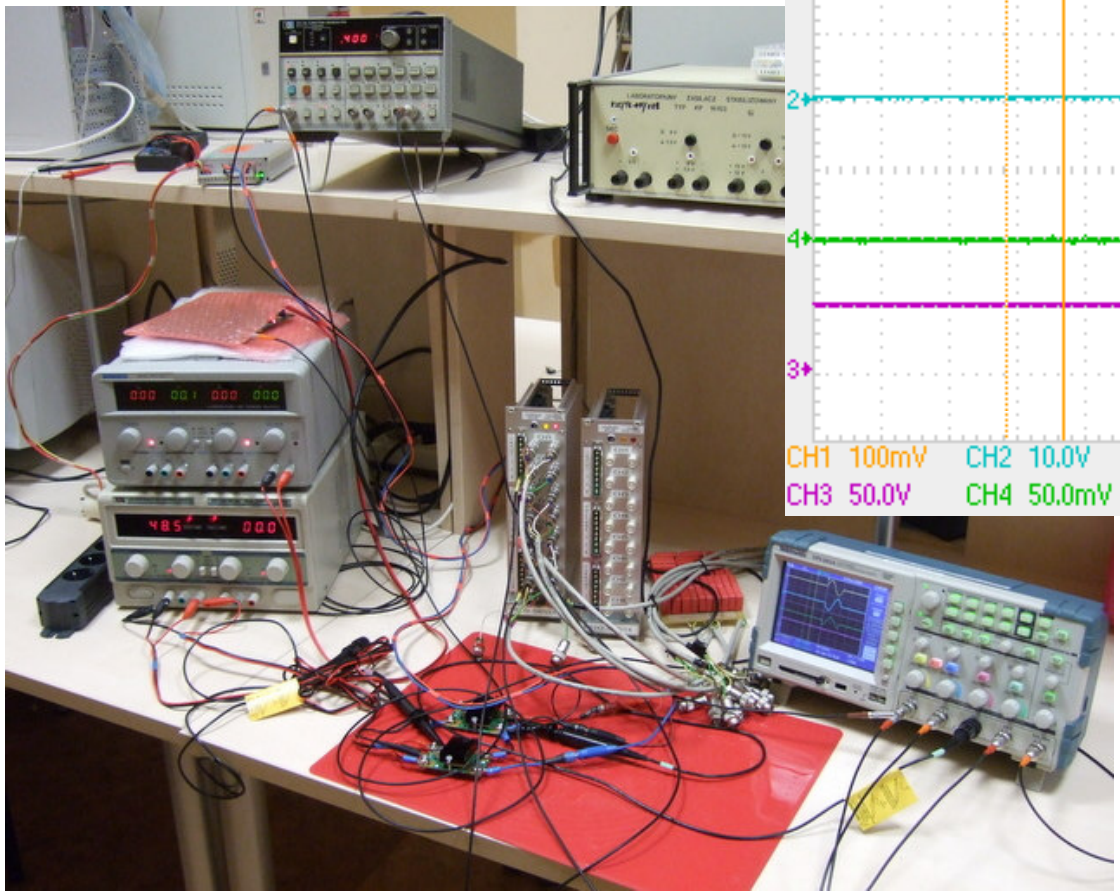
BCM Tests

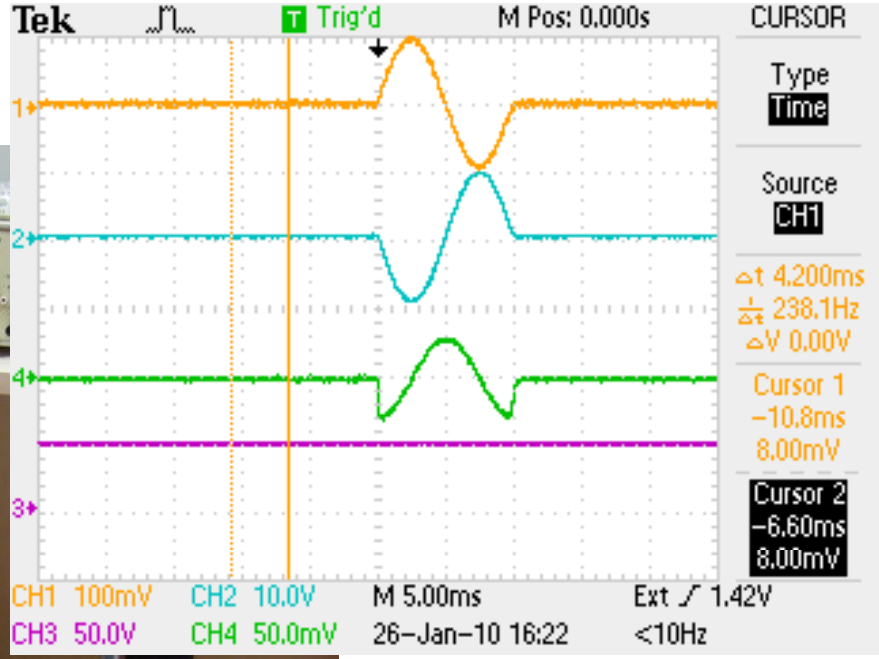

η=f(V_IN)
44 Ohm
68 Ohm
100 Ohm
0.96
0.94
0.92
0.90
0.88
0.86
η
35
40
45
50
55
V_IN [V]


-48V
BCM
BCM
BCM
BCM
Load
Load
+100V
-100V


VICHIP
BCM
VICOR

Power Supply Tests



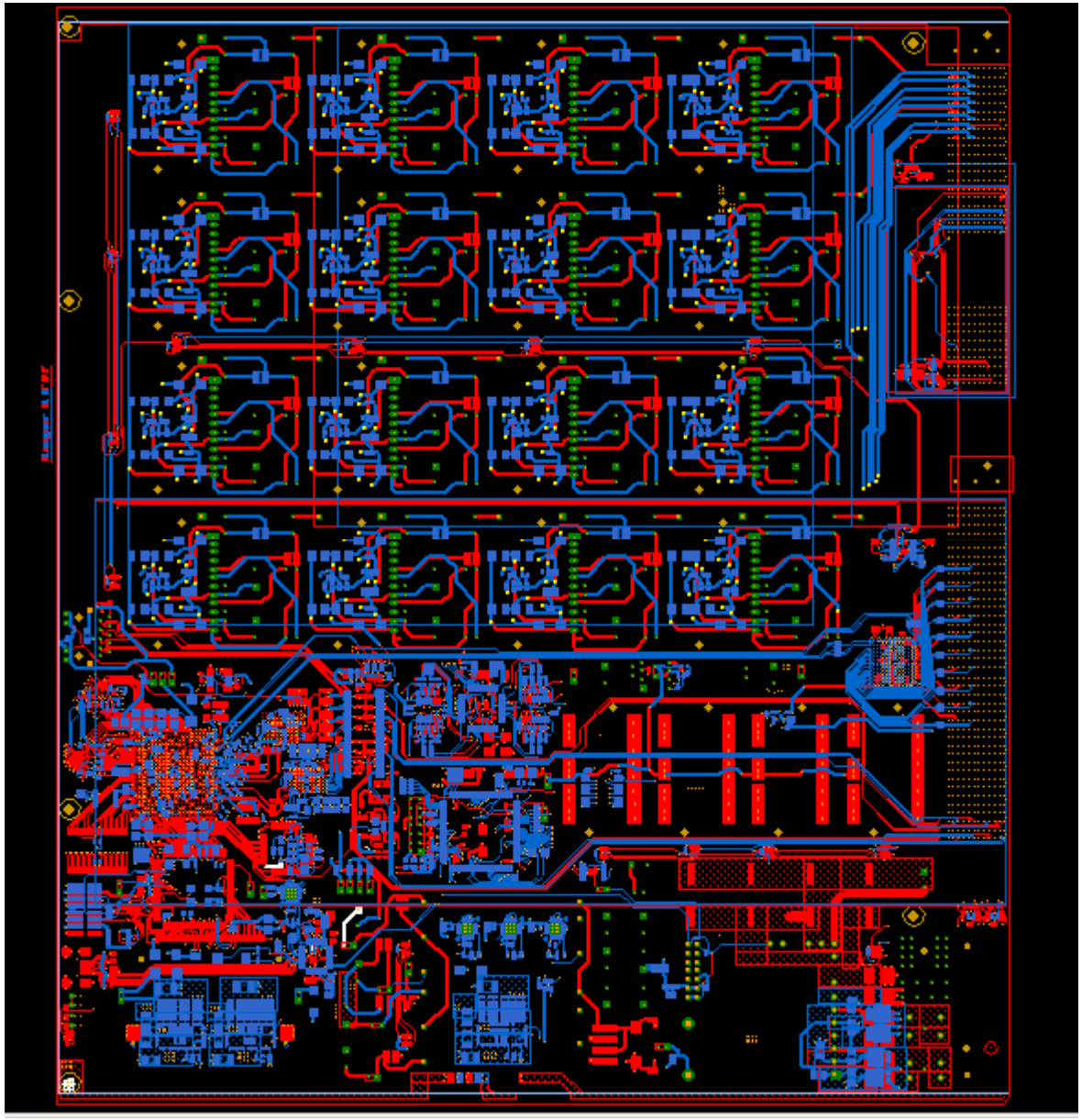


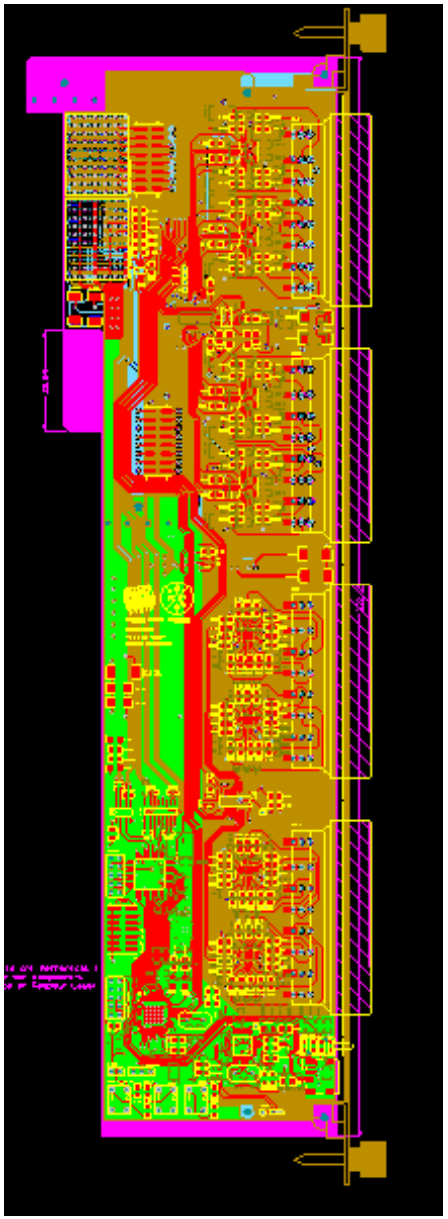
8-channel Piezo driver
loaded with 5 µF capacitance

Conclusions and Outlook

- Concept design accomplished (100%) (16xdriving/16xsensing/integrated current-voltage-temperature-monitorings/integrated bipolar power supply),
- Electrical schematics accomplished (100%),
- PCB layouts accomplished (100%),
- Fabrication, laboratory tests and FLASH commisioning scheduled for the end of the year
- Possible migrations to µTCA are considered

Thanks for Your Attention





Power Supply Unit for ATCA – based Piezo Compensation System

We acknowledge funding from the European Commission
under the FP7 Research Infrastructures project EuCARD, grant agreement no. 227579.