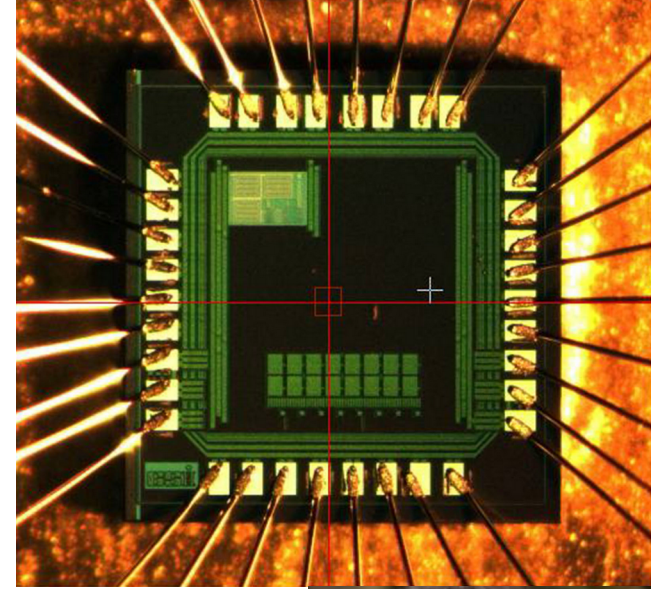


# Series calibration of the slow-control of the barrel part of the PANDA EMC front-end bus system



**gsi**



JUSTUS-LIEBIG-  
UNIVERSITÄT  
GIESSEN

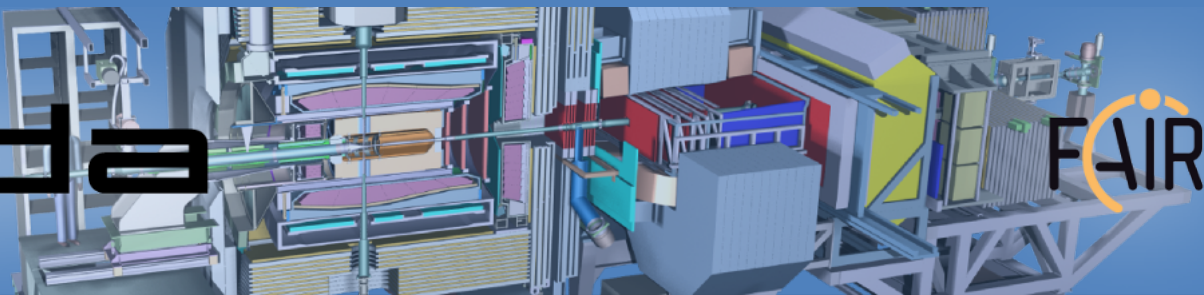
**IPI**  
Experimental Physics II

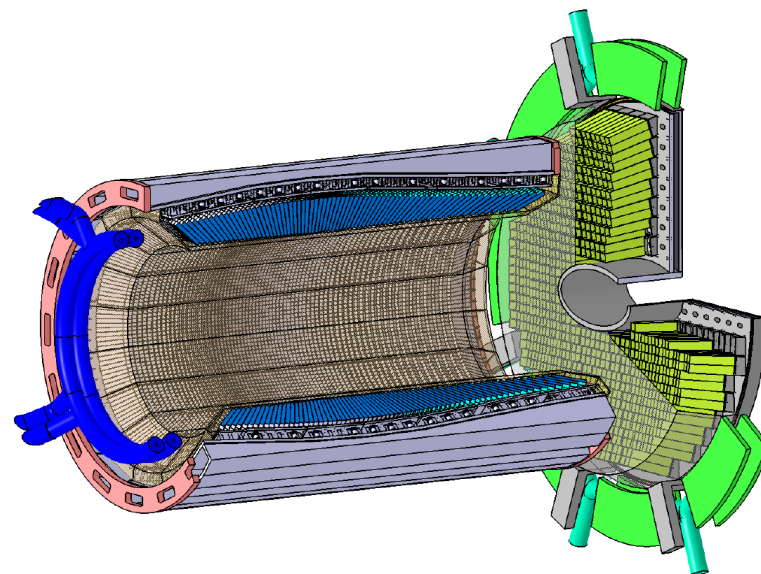
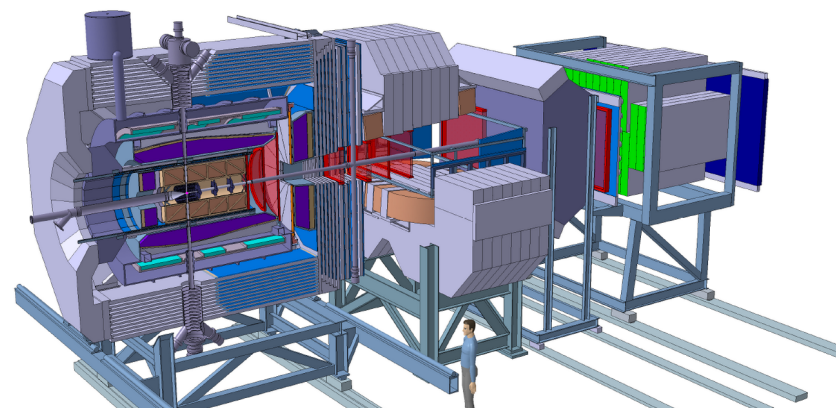
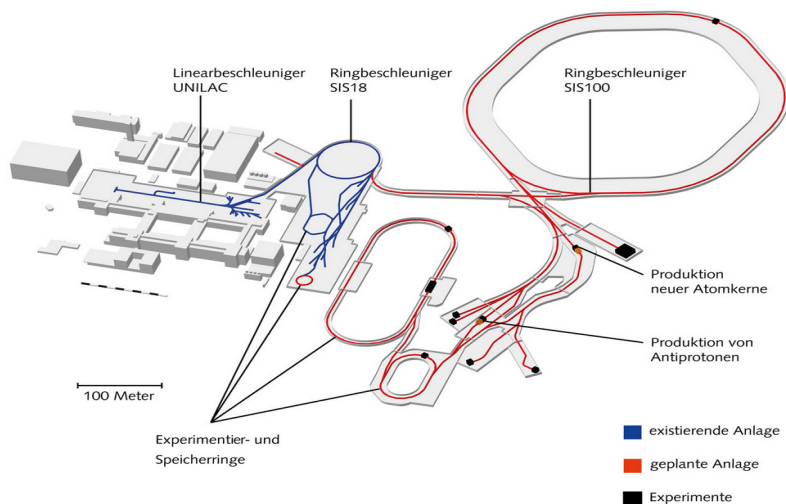
**HFHF**

Christopher Hahn\* for the PANDA collaboration

\*2nd Physics Institute, University Giessen, Germany

**panda**

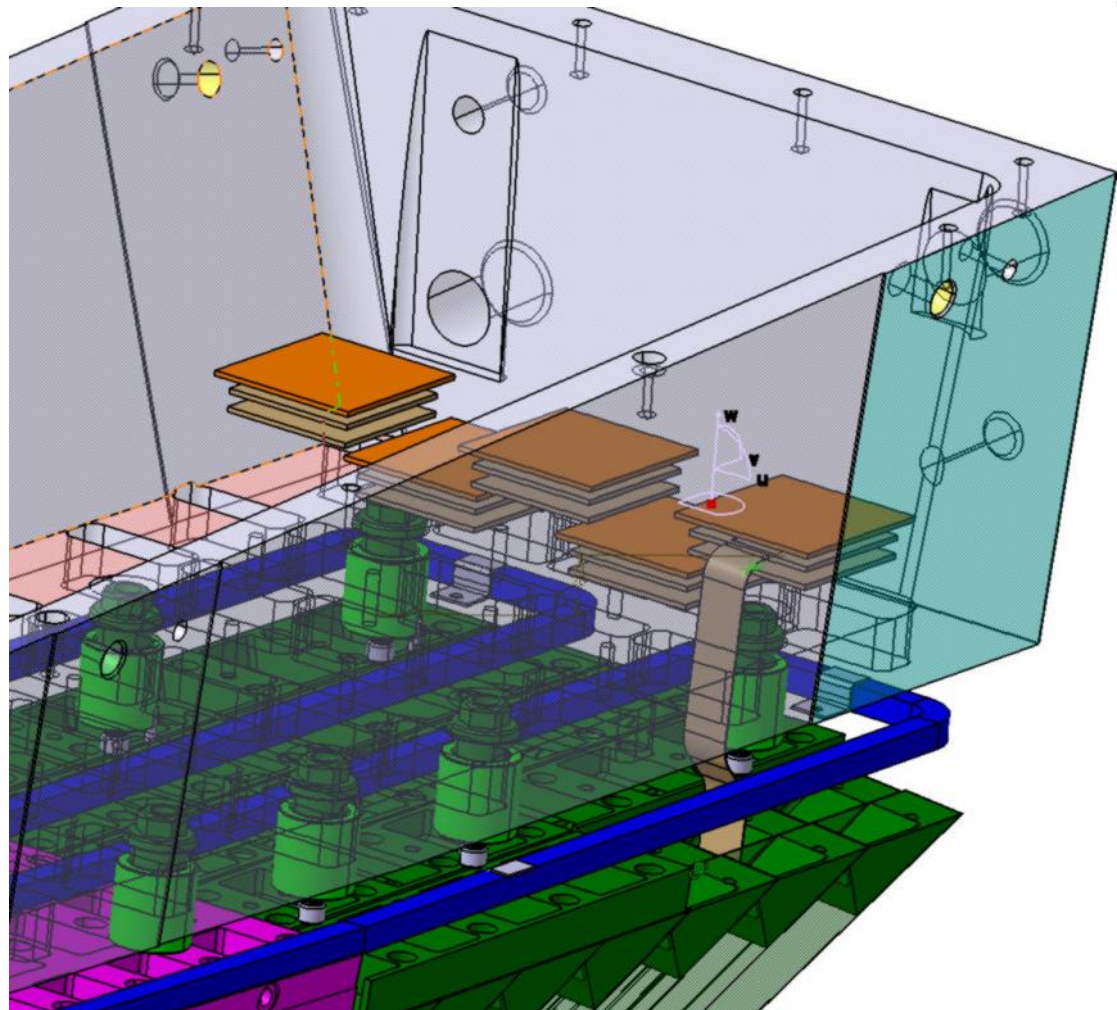




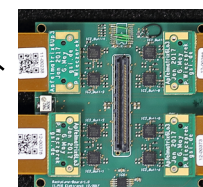
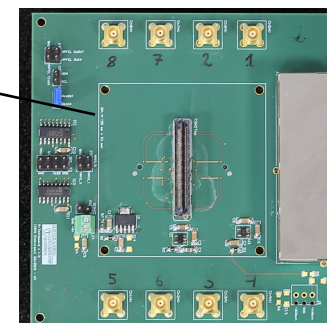
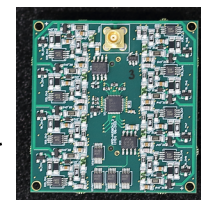
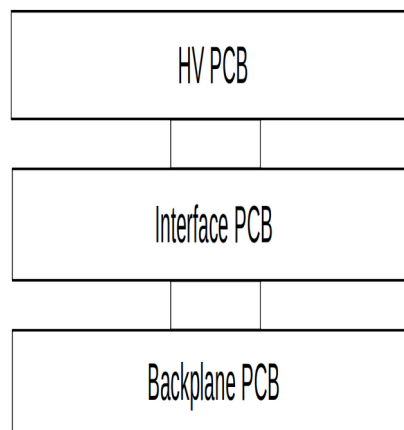
- 11200 PWO-II crystals in PANDA Barrel EMC (in 16 slices)
- 22400 Large-Area Avalanche Photo Diodes (APDs)
  - each APD needs individual adjustable high-voltage
  - one backplane supplies eight APDs

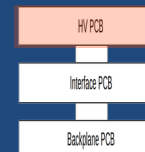


- **Triple PCB setup**
  - HV distribution & regulation
  - Connector board for custom signal cables
  - Board for FlexPCBs / ASICs
    - Connectors to FEs
    - 8x2 Diff. Line drivers
    - APFEL I/F buffers
    - Temp/Humidity sensors

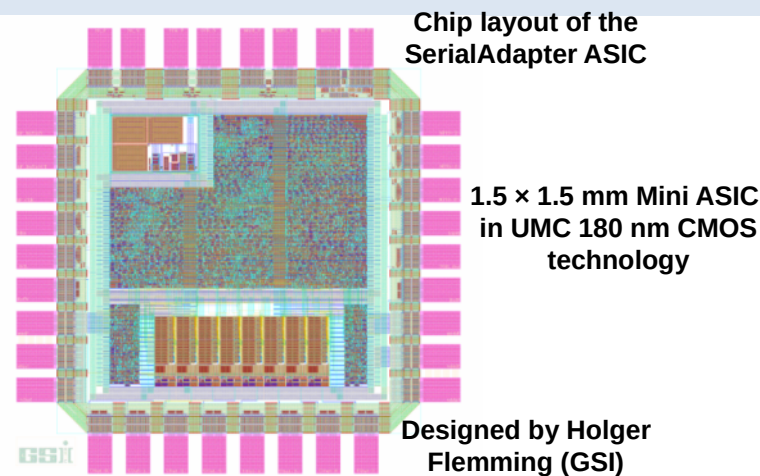


- **HV PCB**
  - HV distribution & regulation
  - Temp sensor, other I2C Chips
- **Interface PCB**
  - Connector board for custom signal cables and low power supply (6V)
- **Backplane PCB**
  - Board for FlexPCBs / ASICs
  - Connectors to FEs
  - APFEL I/F buffers
  - Temp/Humidity sensors

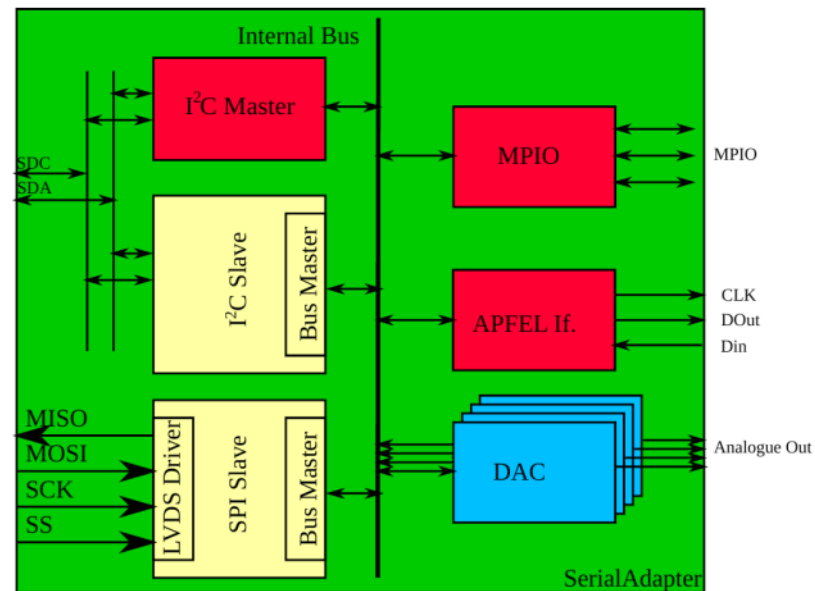
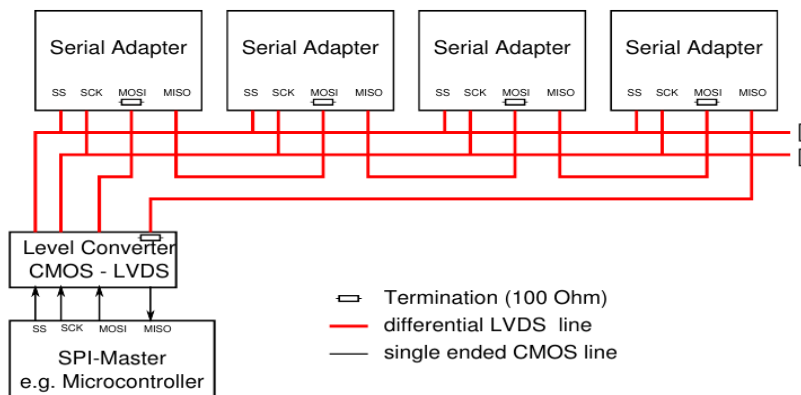




- Daisy Chaining of backend-Interface for 5 (10) backplane PCBs for preseries slice → Saves 4/5 of slow control cables (36 vs. 180)
- 180 Backplanes per slice needed
  - 200 with ~10% margin
  - 3200 for full barrel
- Voltage range can be adjusted, according to APD matching
- Use DACs for HV adjustment

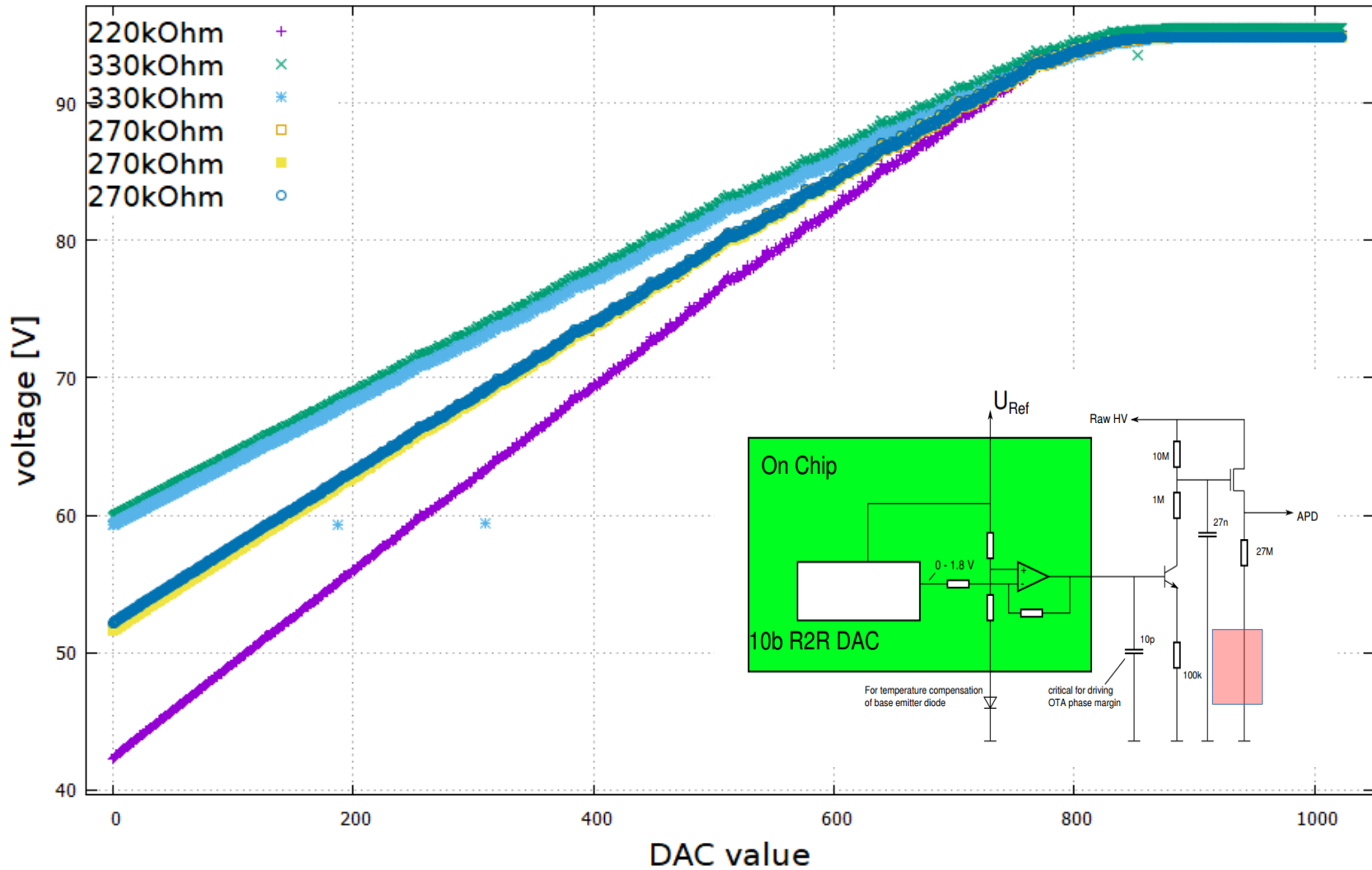
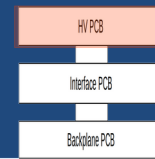


Using a daisy chained SPI interface

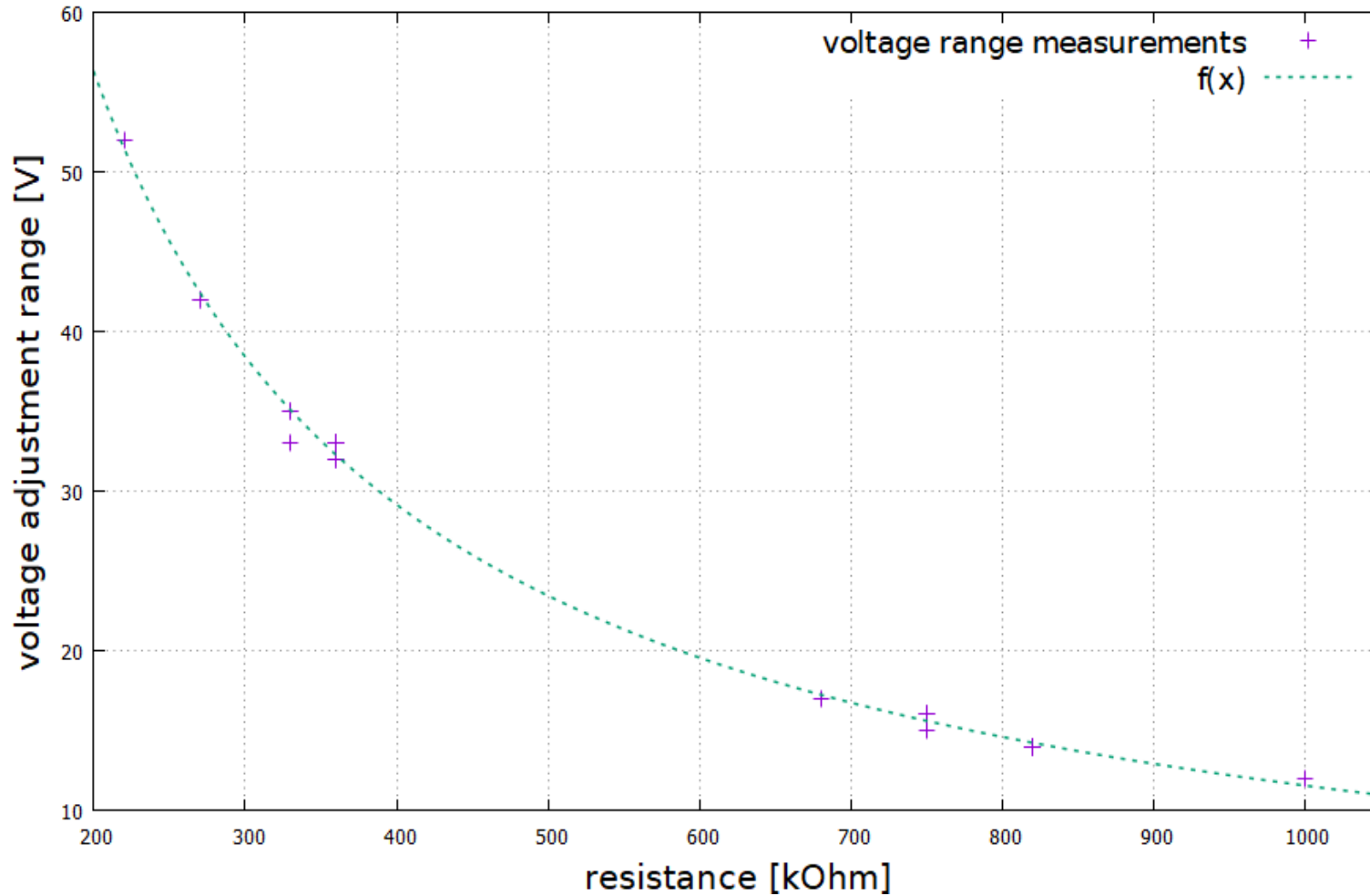
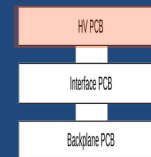




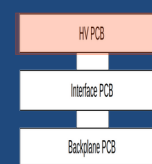
# High-Voltage Adjustment Range



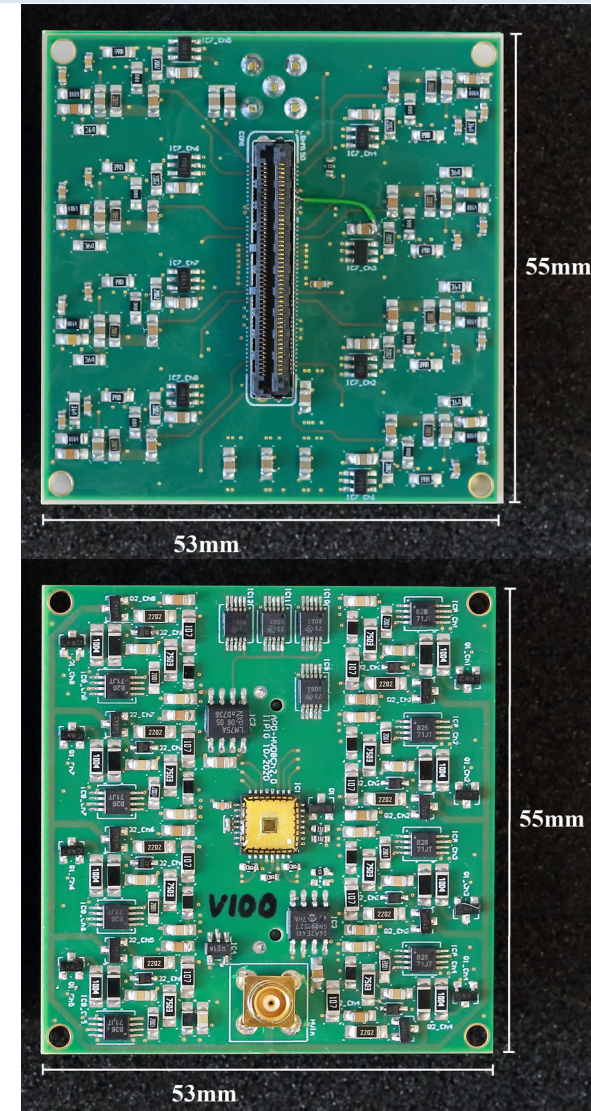
# High-Voltage Adjustment Range



# Preseries Prototype Version of HV Board

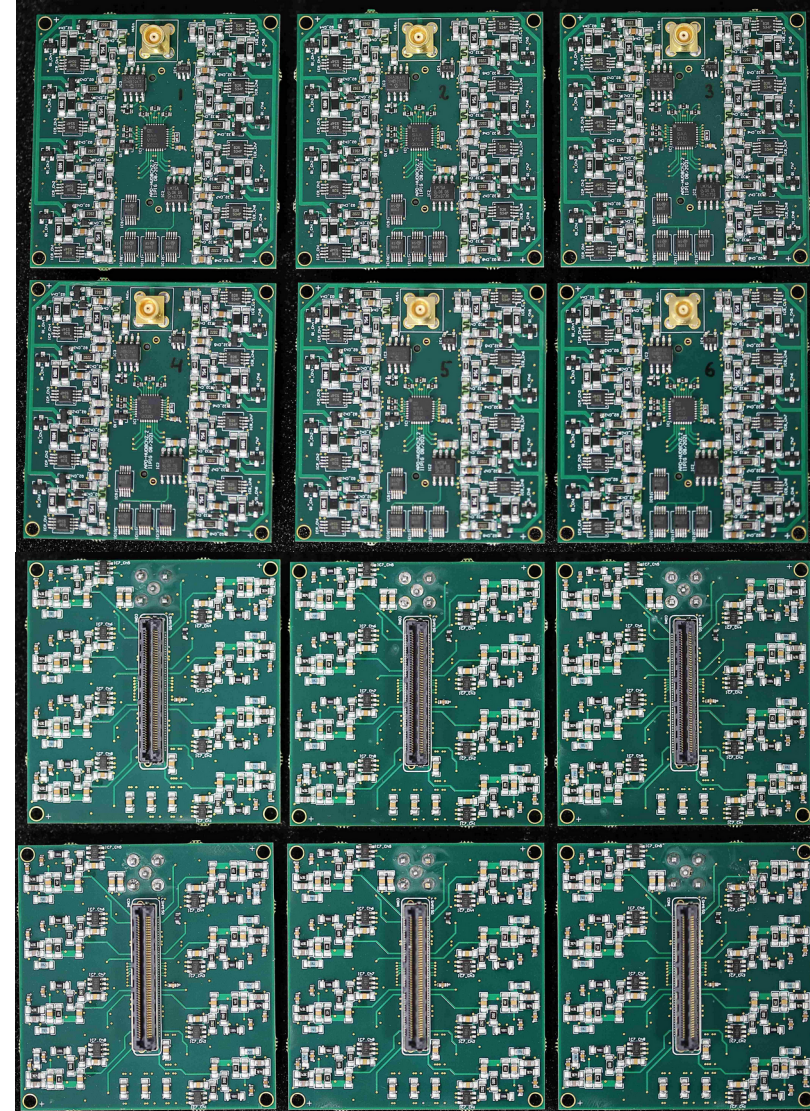
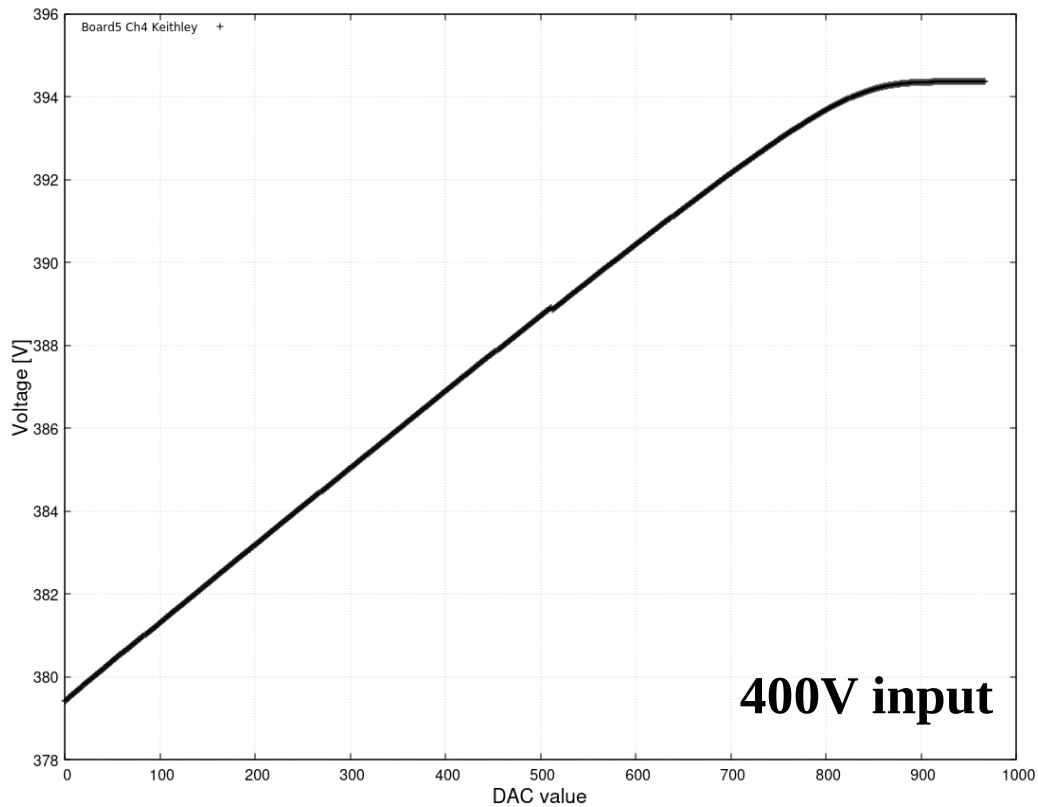


- **HV PCB went through several iterations**
  - SAA V110 with improved DAC
  - 34V range → ~15V range
  - 37mV accuracy → ~17mV accuracy
- **Final fixes and ordering of the HV PCBs for the preseries slice were done in 2021**
  - Preseries Prototype of HV PCB is used for further tests
  - Production of 200 HV PCBs for preseries slice is ongoing
  - First batch arrived for quality control in Feb 2022

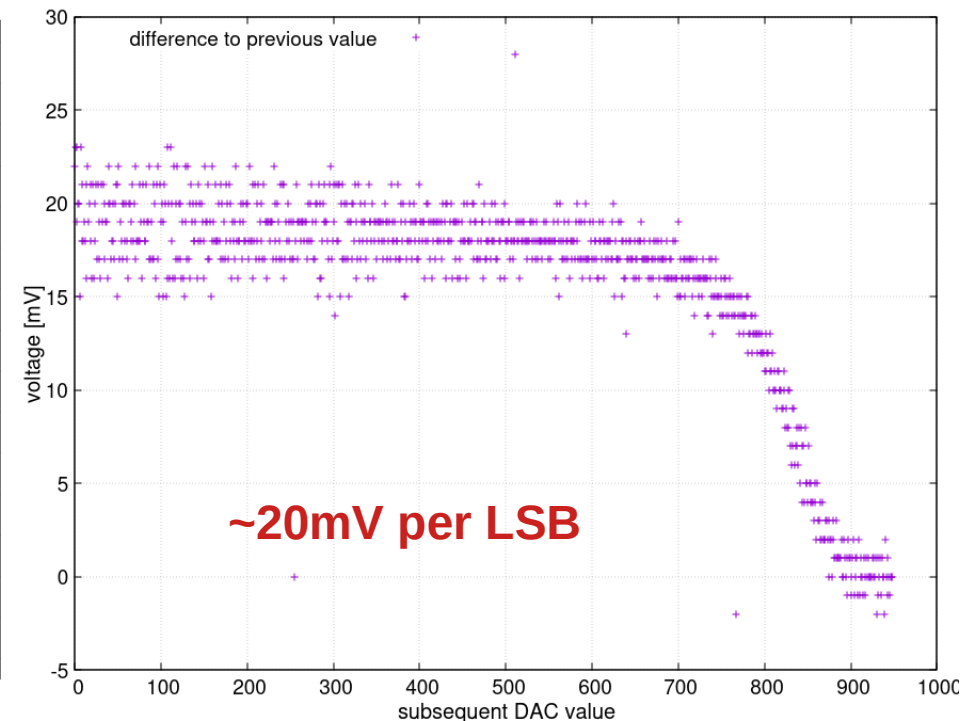
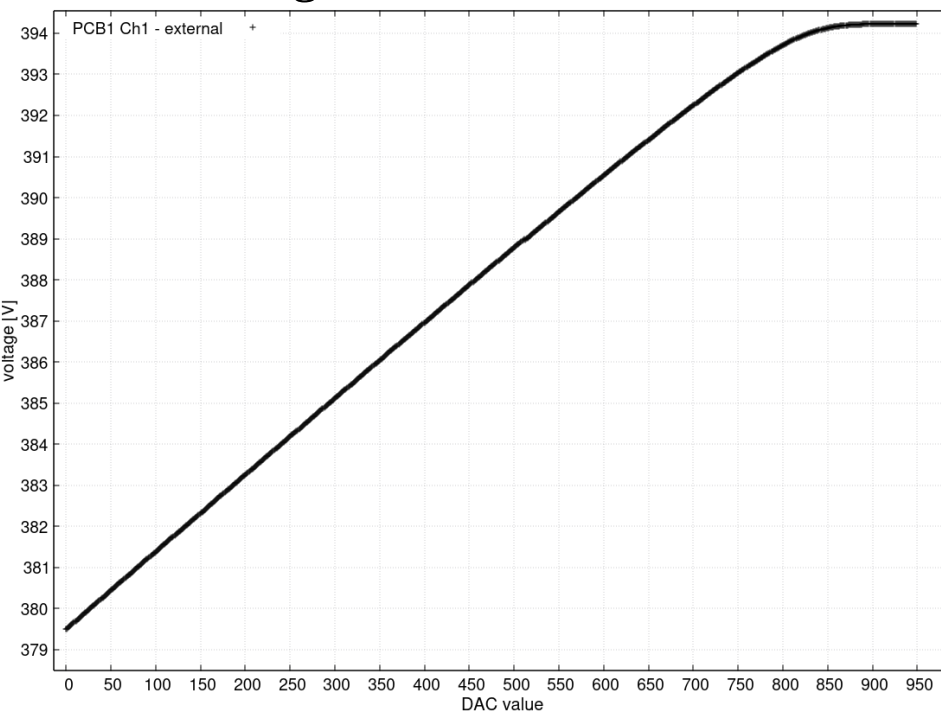


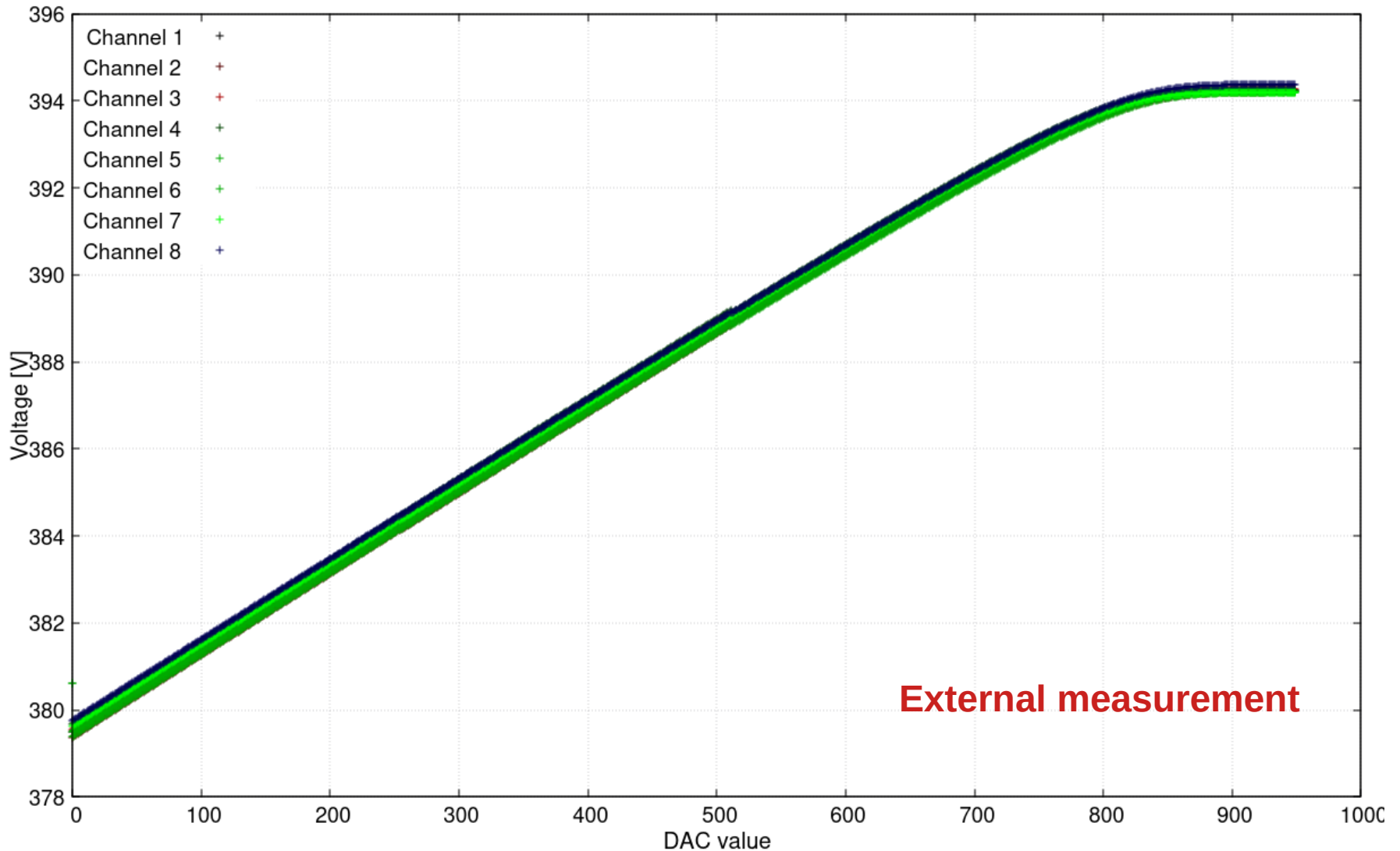


- **Production of 200 HV PCBs for preseries slice is ongoing**
  - **First batch arrived for quality control in Feb 2022**

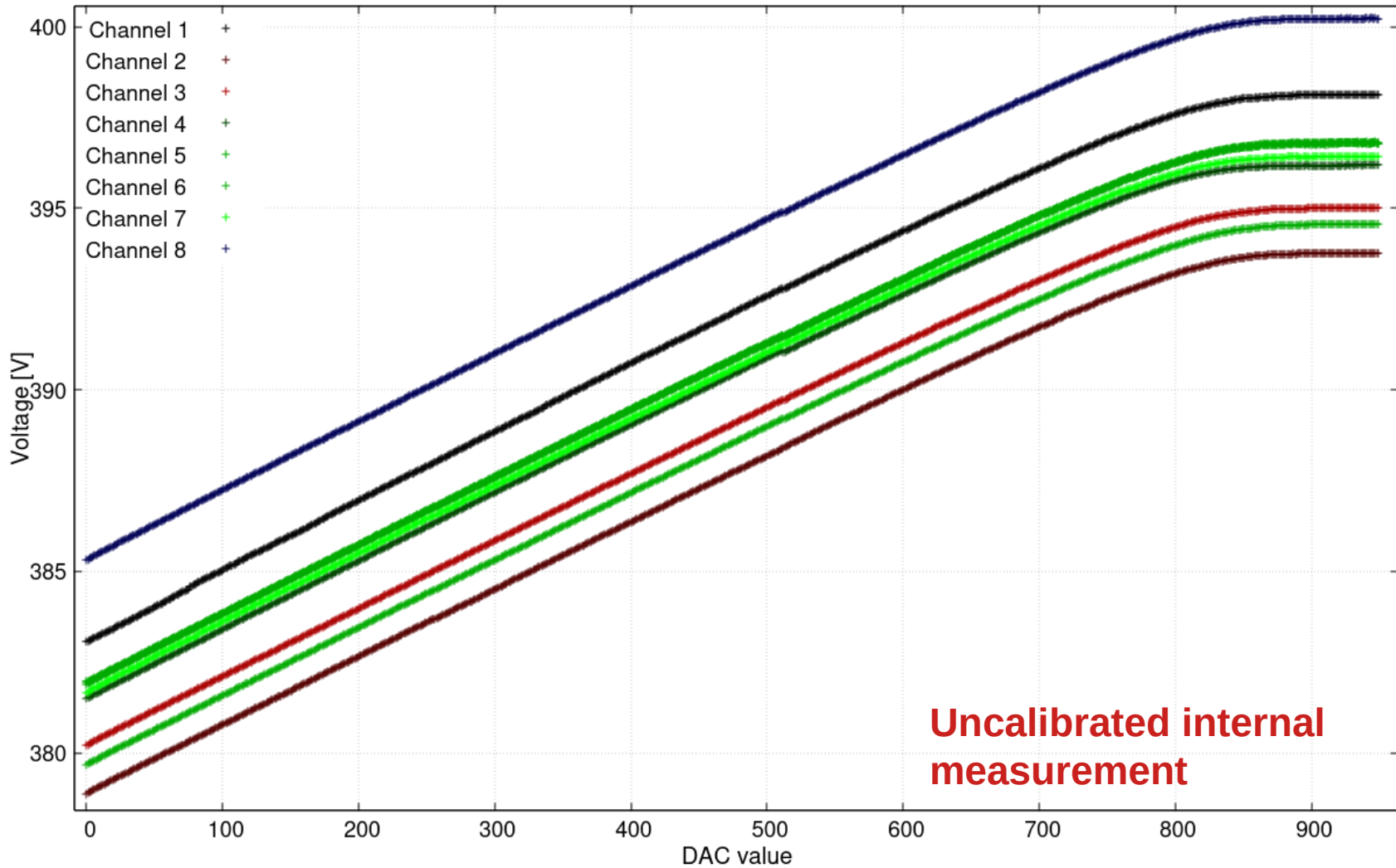
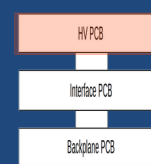


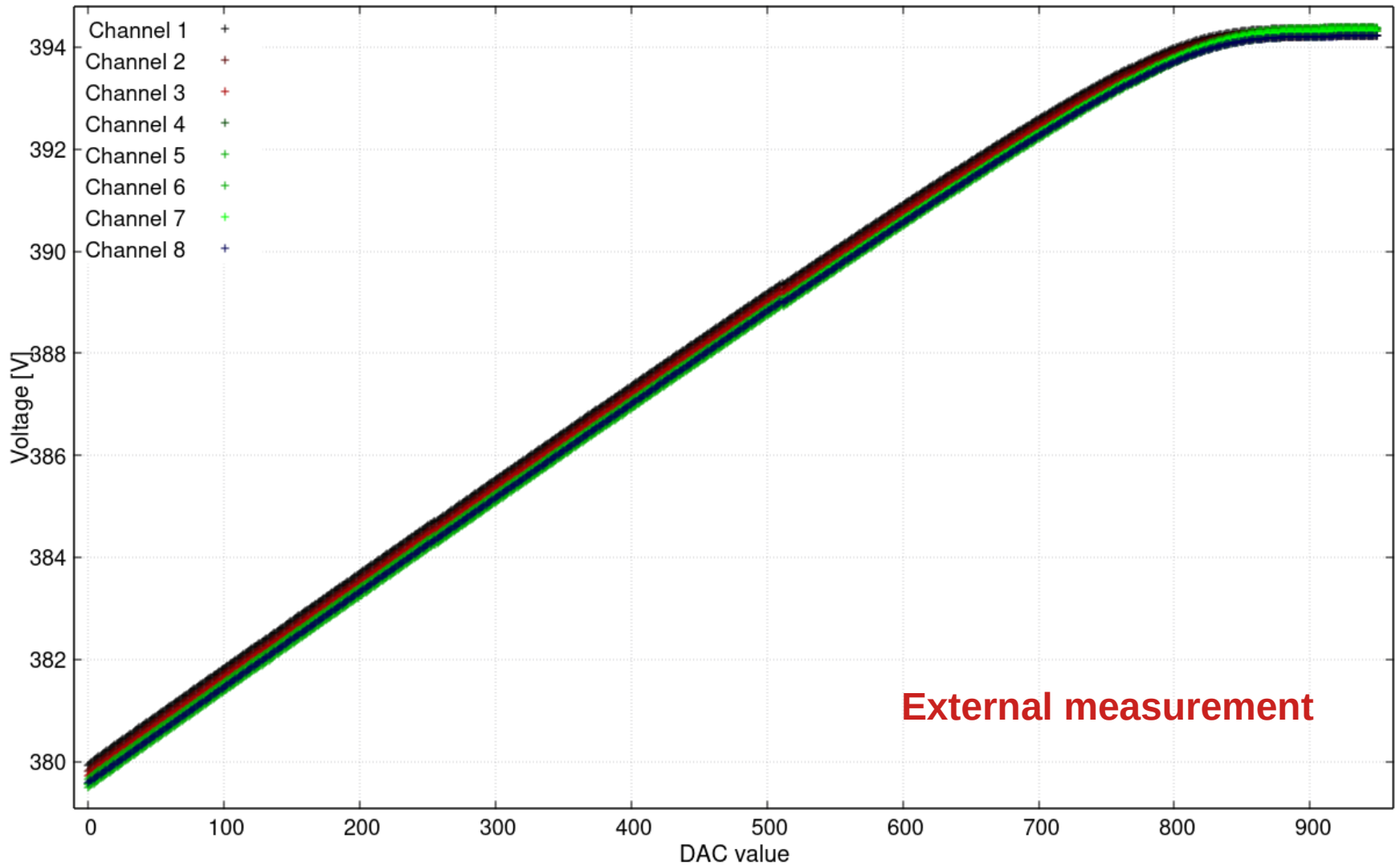
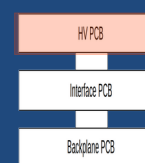
- **All 6 PCBs of the first batch work**
  - All bus systems function as expected
  - APFEL communication is operational
  - all I2C components communicate
  - High voltage adjustment at 400V input voltage is adjustable in a range of  $\sim 379\text{V}$  to  $\sim 394\text{V}$

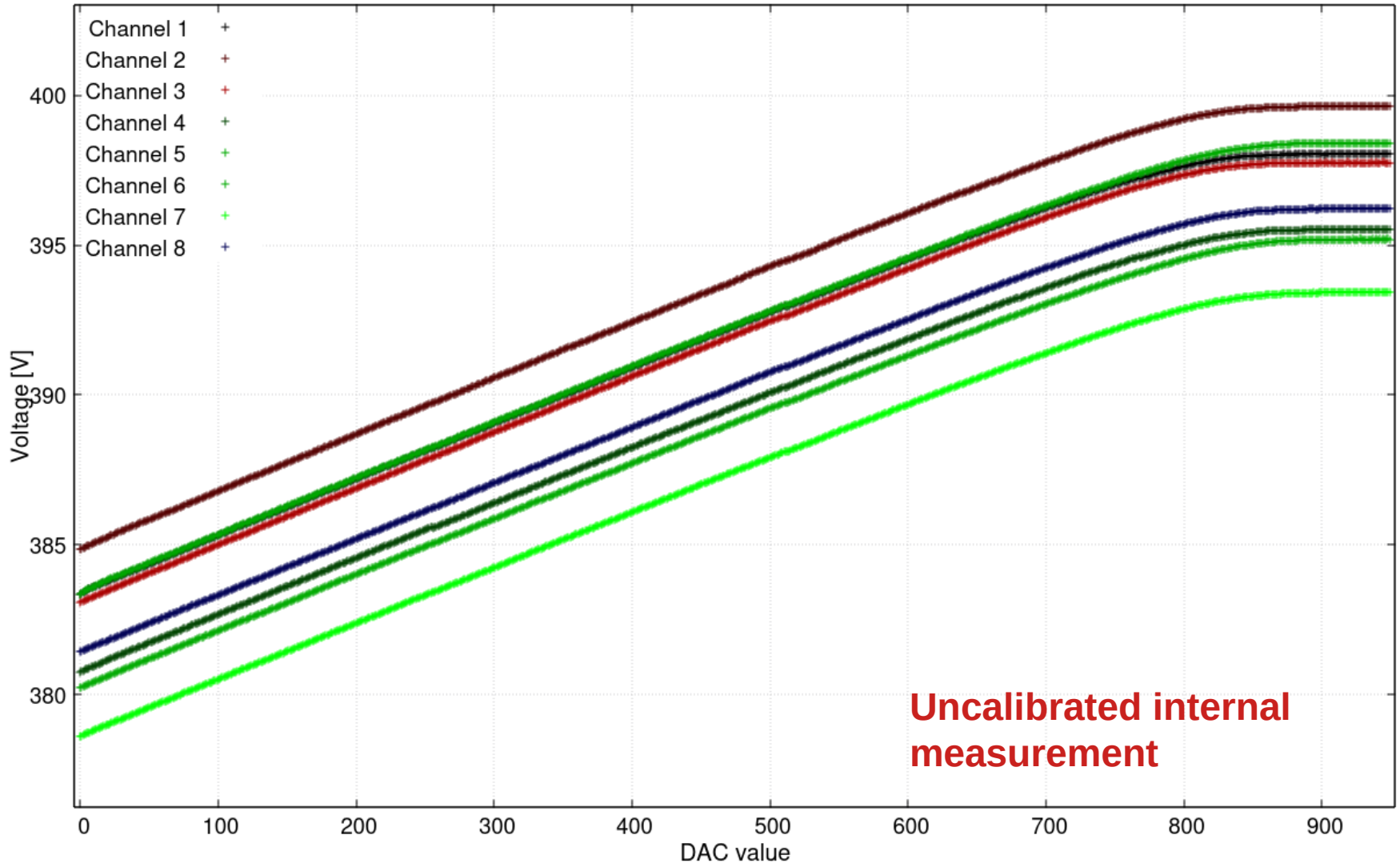
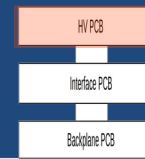




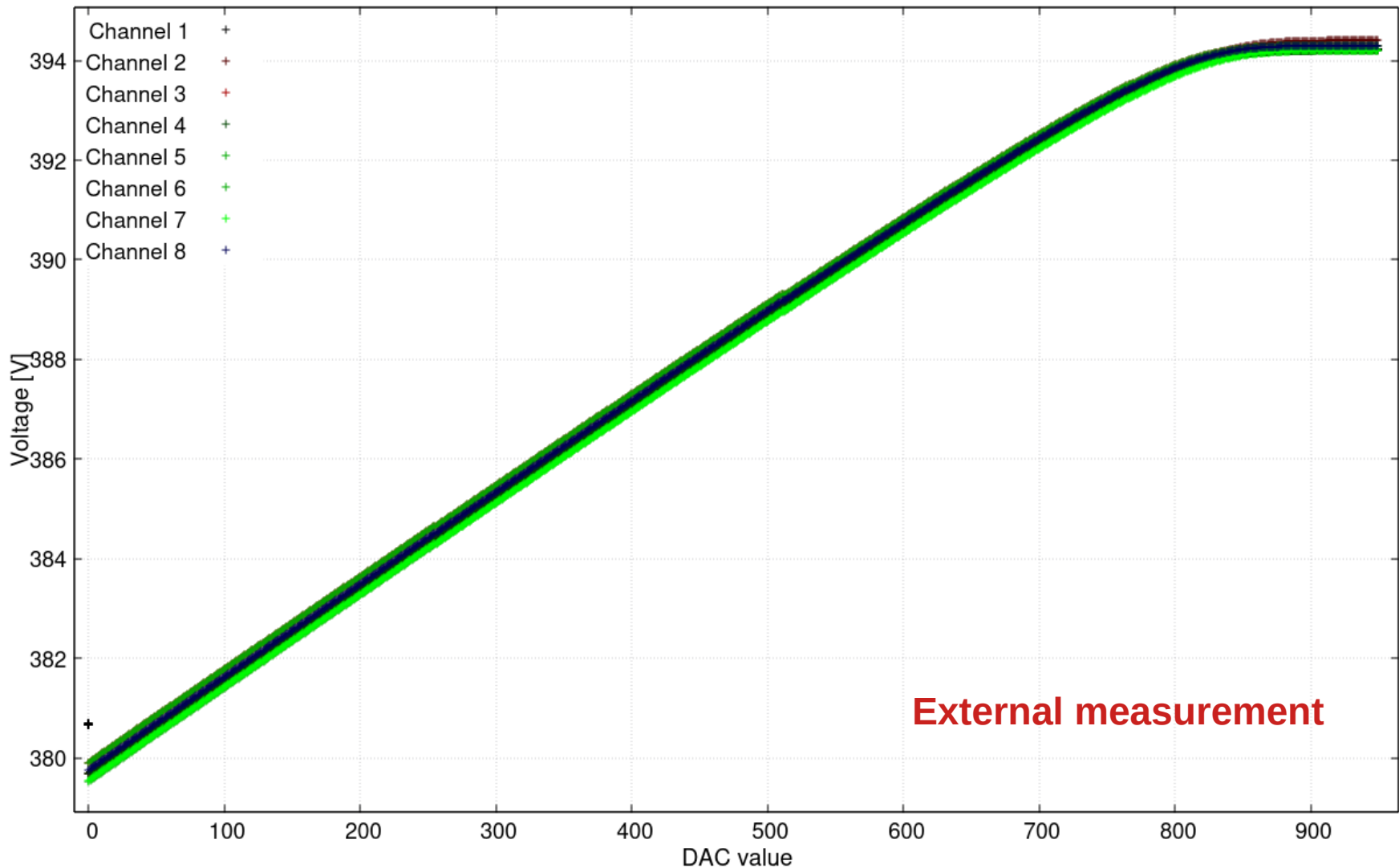
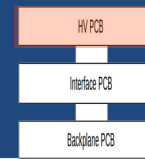


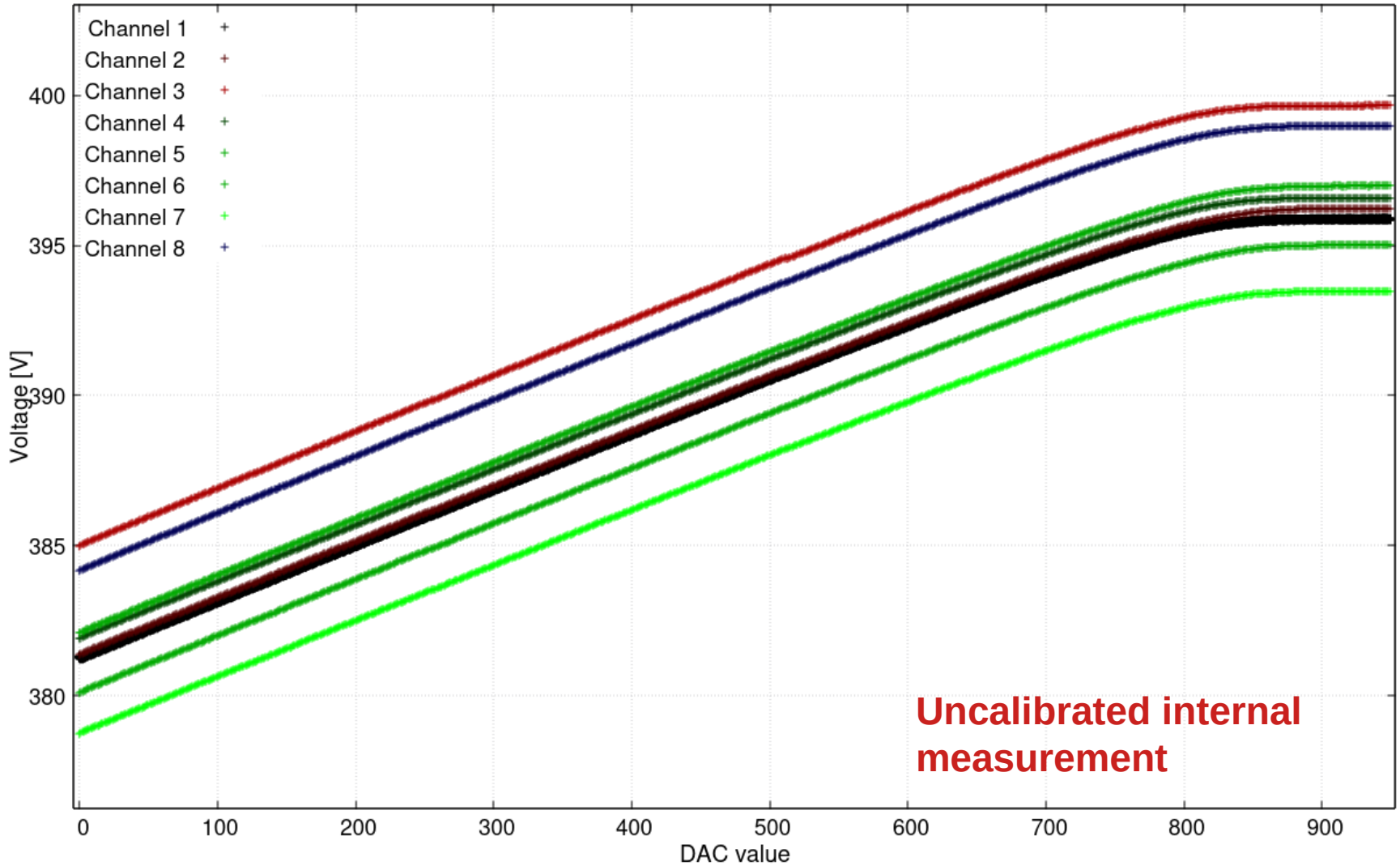


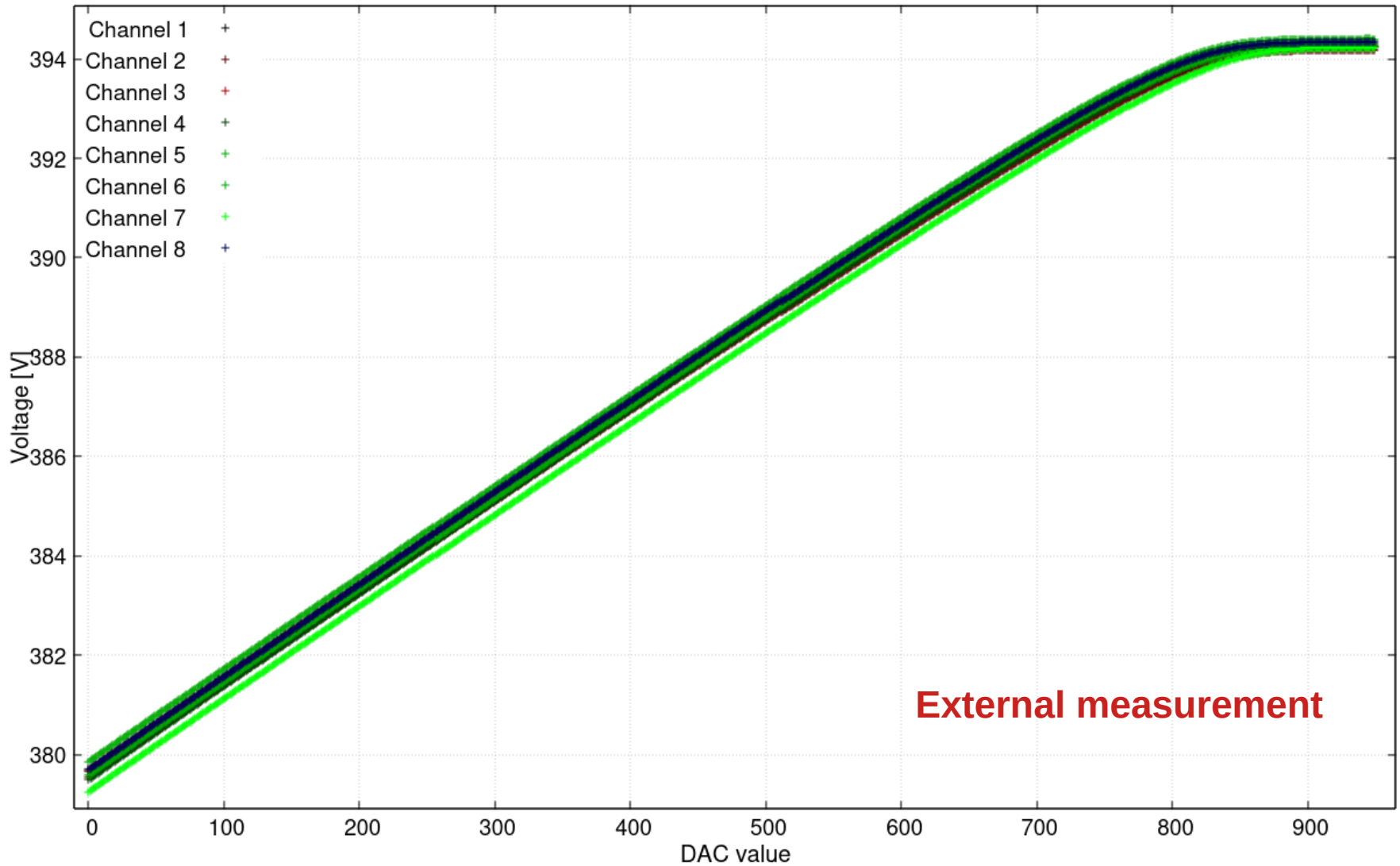


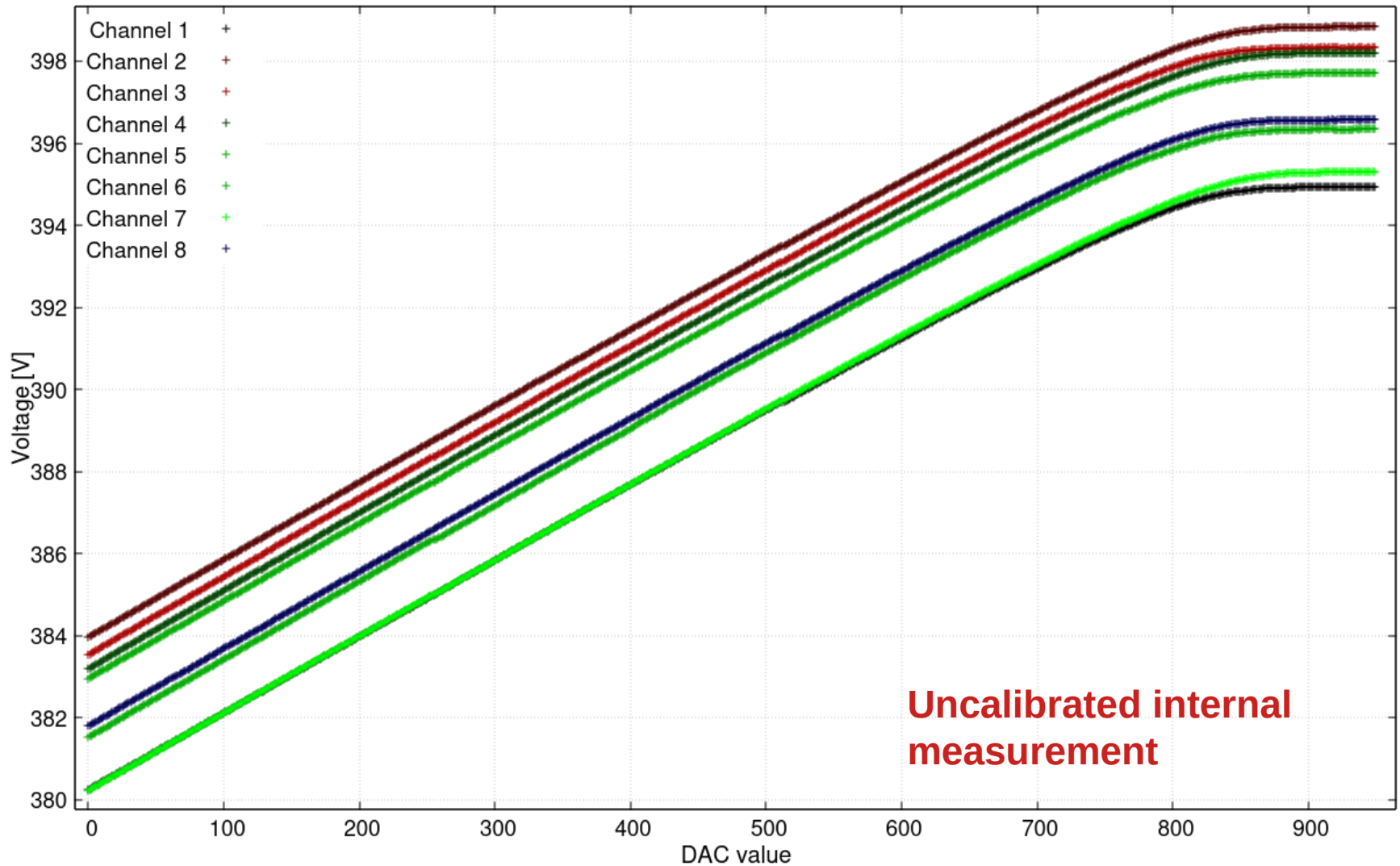
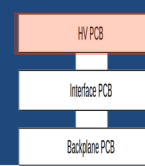






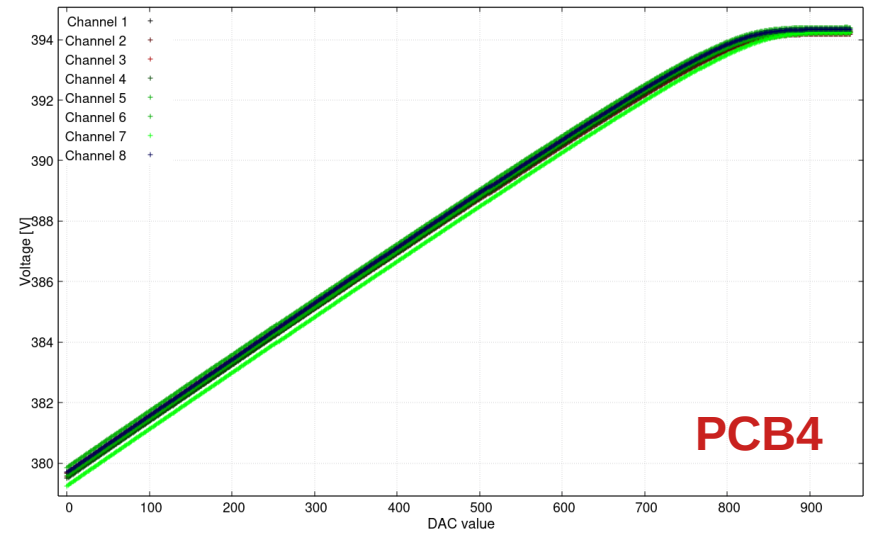
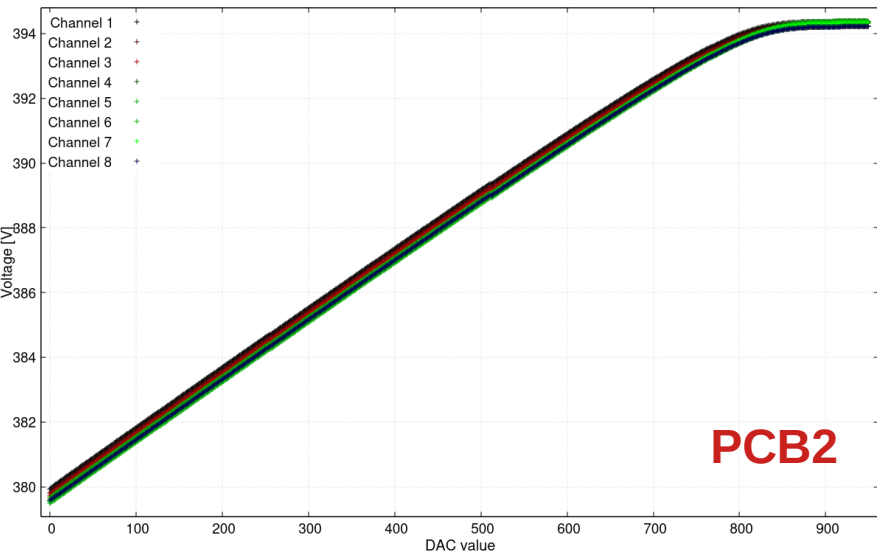
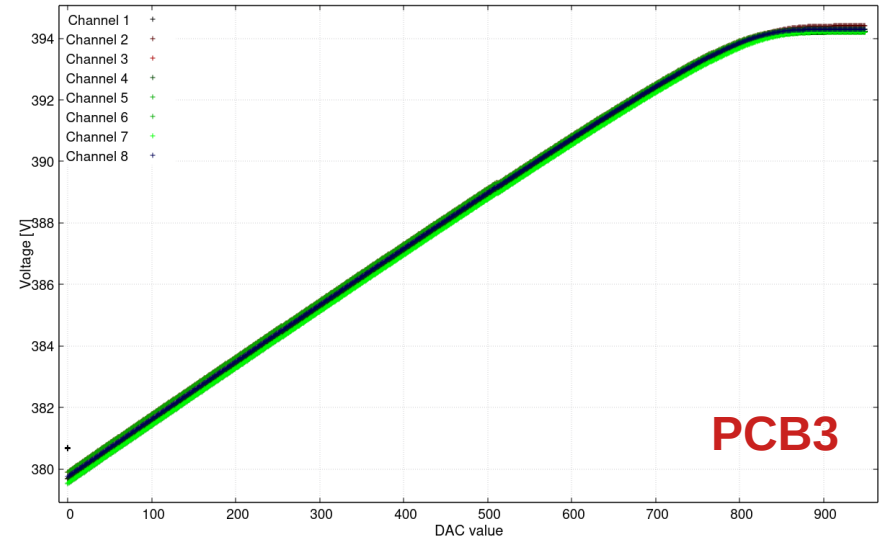
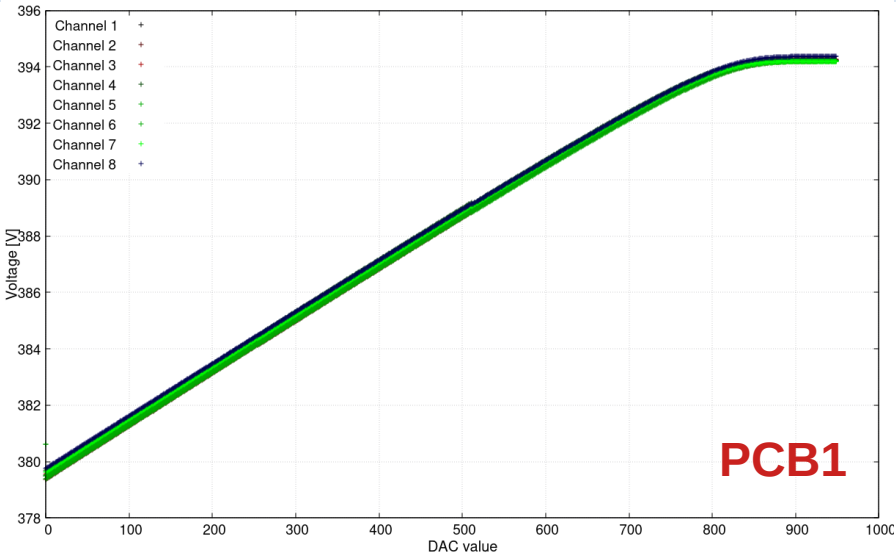
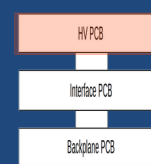


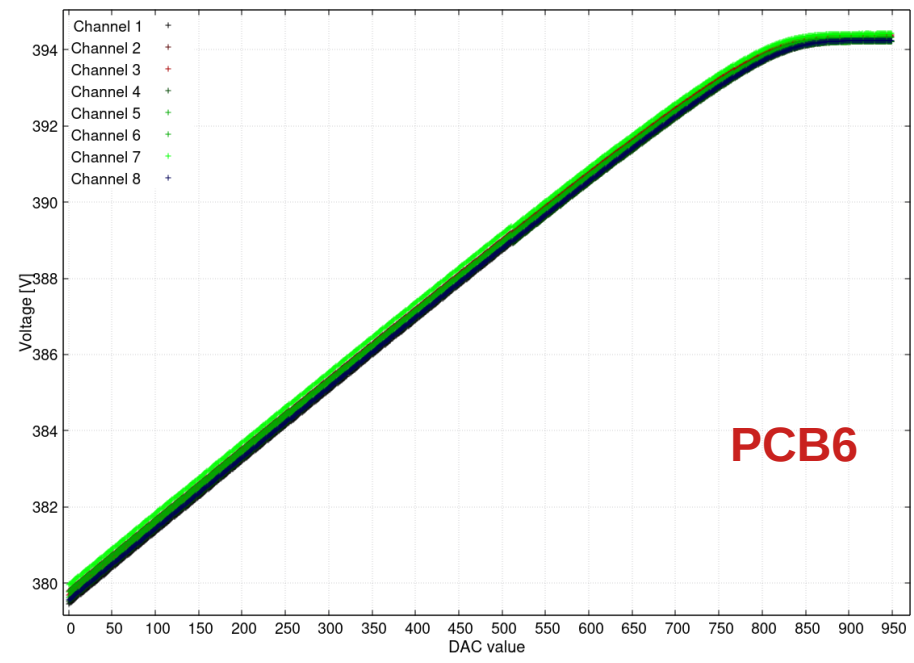
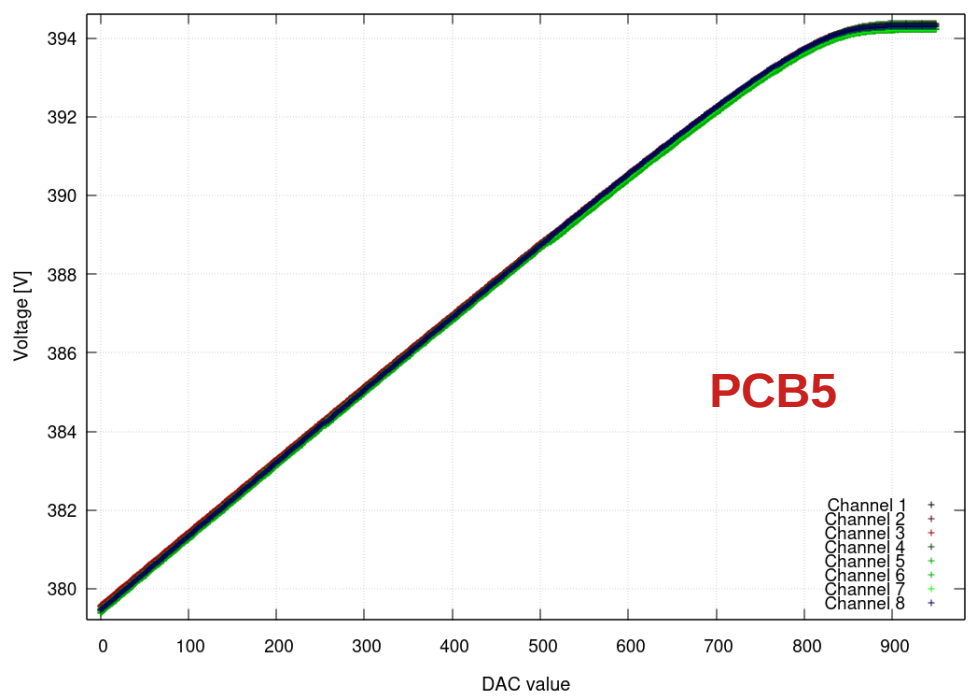
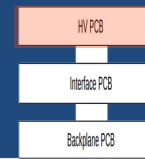




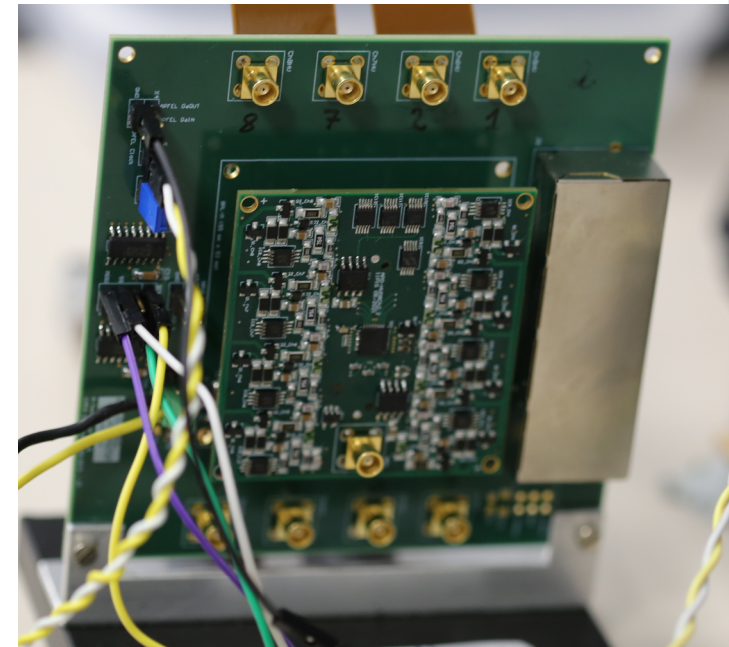
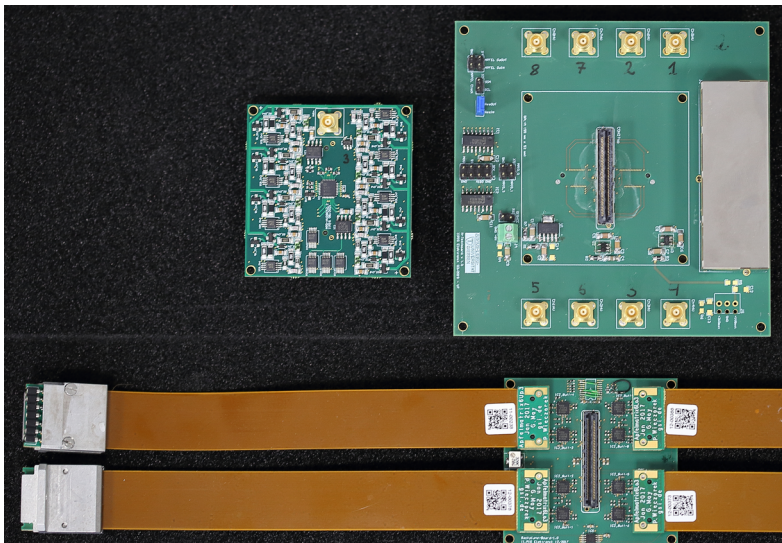


# First Batch - PCB 3

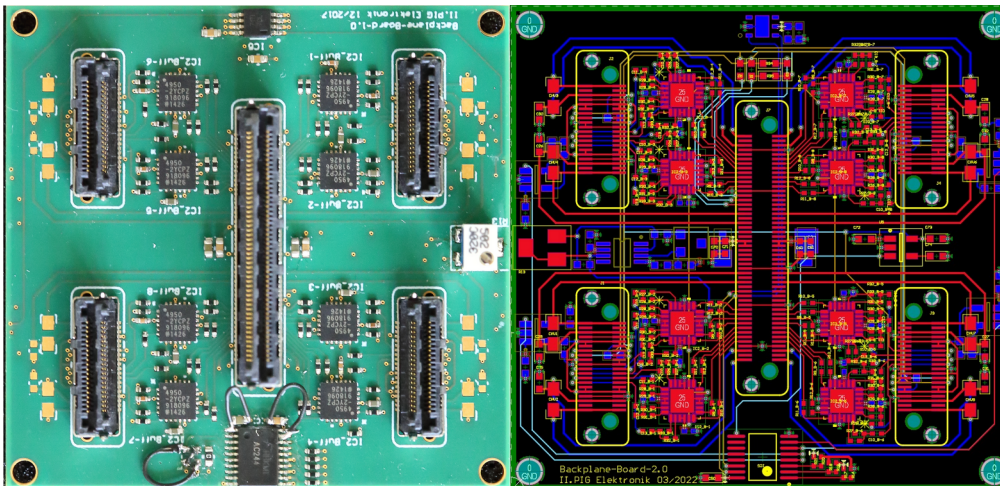
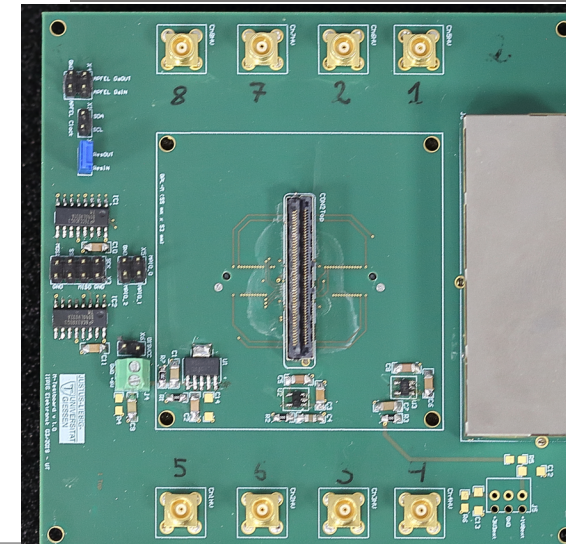
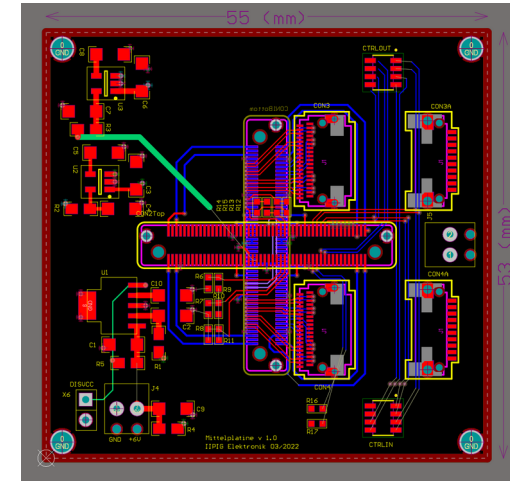




- **Preperation for series tests ongoing**
  - **preperation of several interface PCBs**
  - **Multimeter/Switch setup in preperation**
- **Two new Bachelor students will work on existing setup**

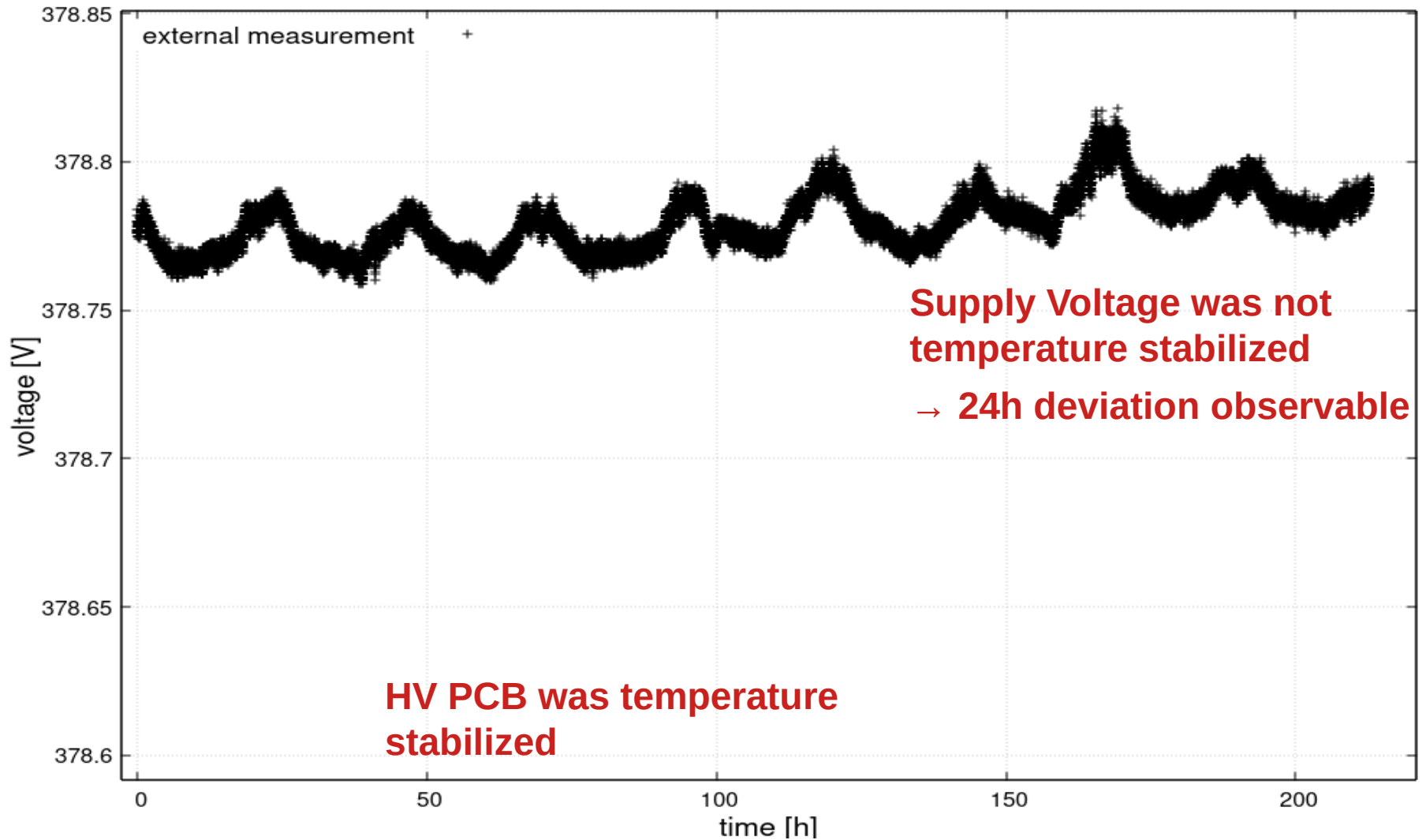


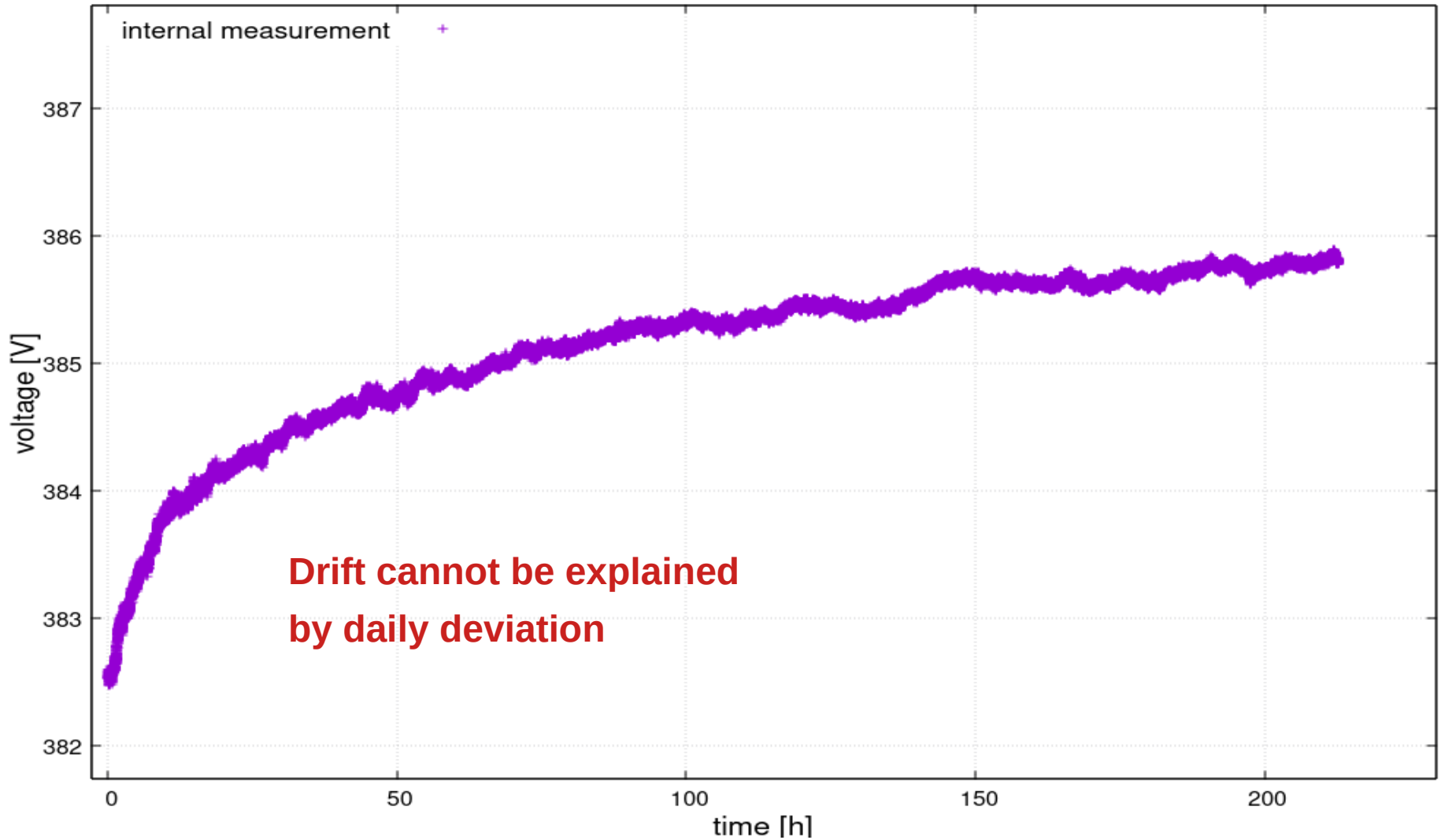
- Updated Backplane version in production
  - several configuration jumpers added
  - not needed components removed
- Updated Interface PCB in design/production stage

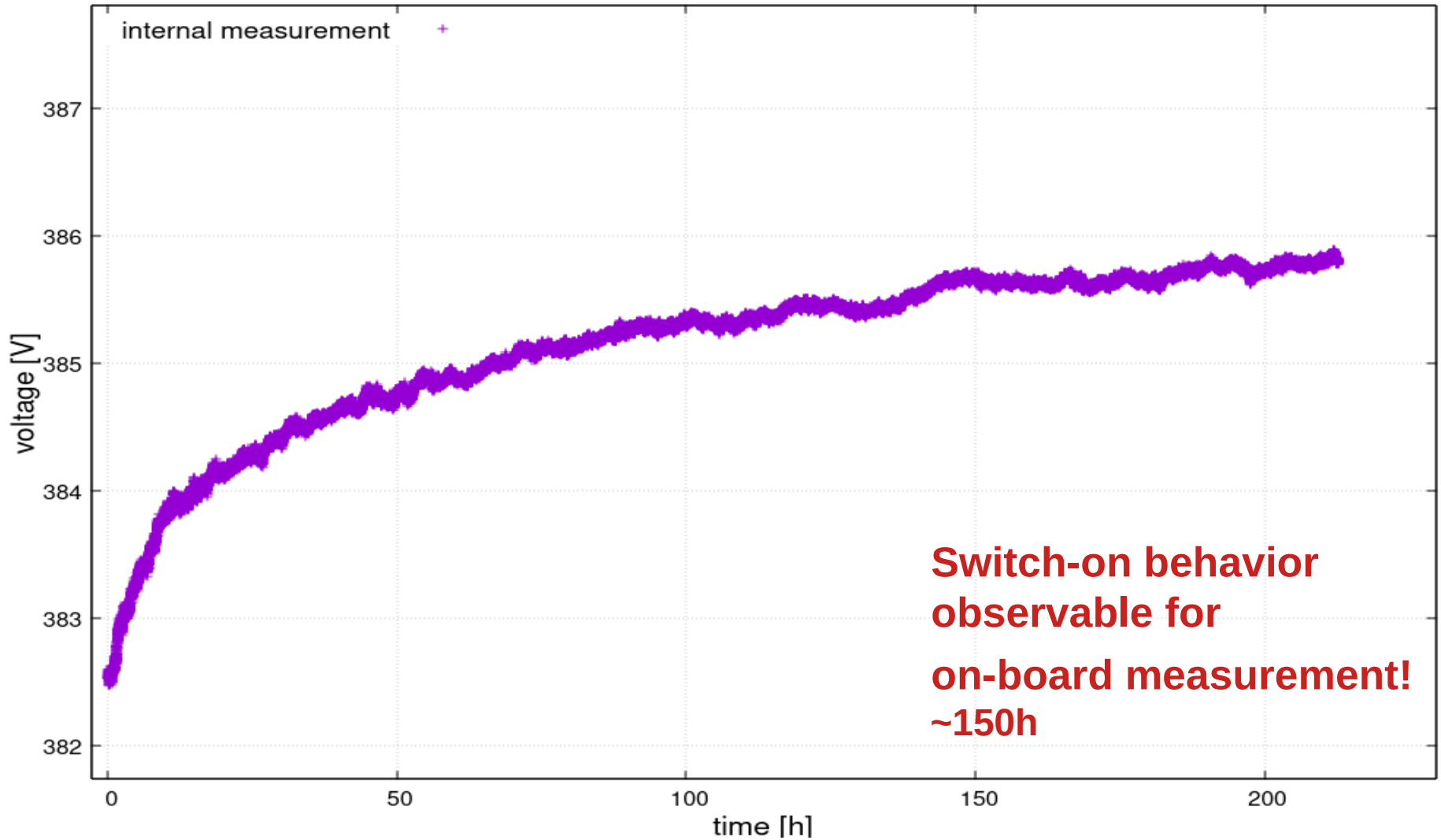




**Which parameters should be taken into account for series tests and calibration?**

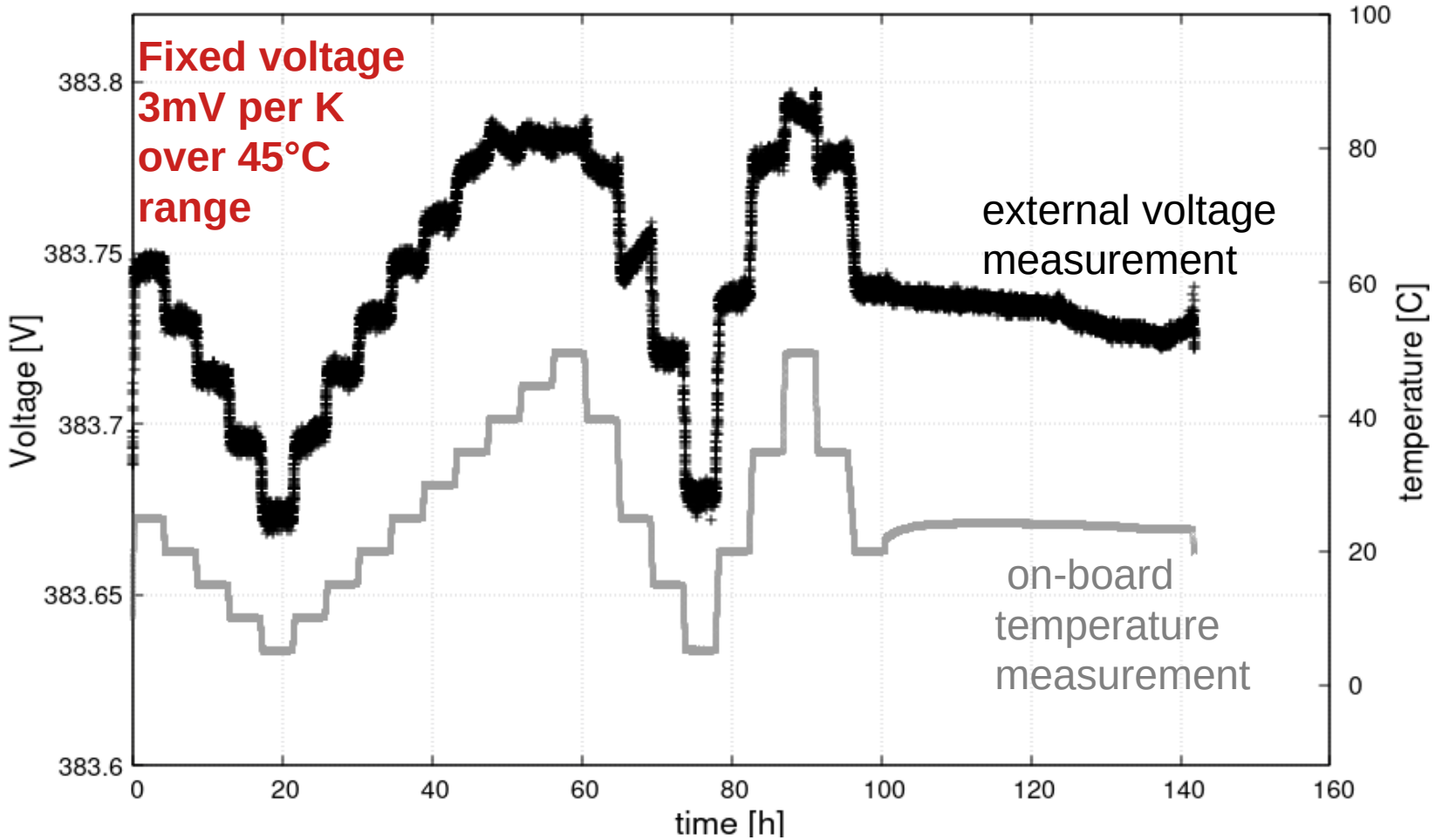
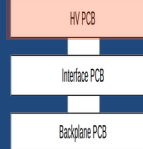




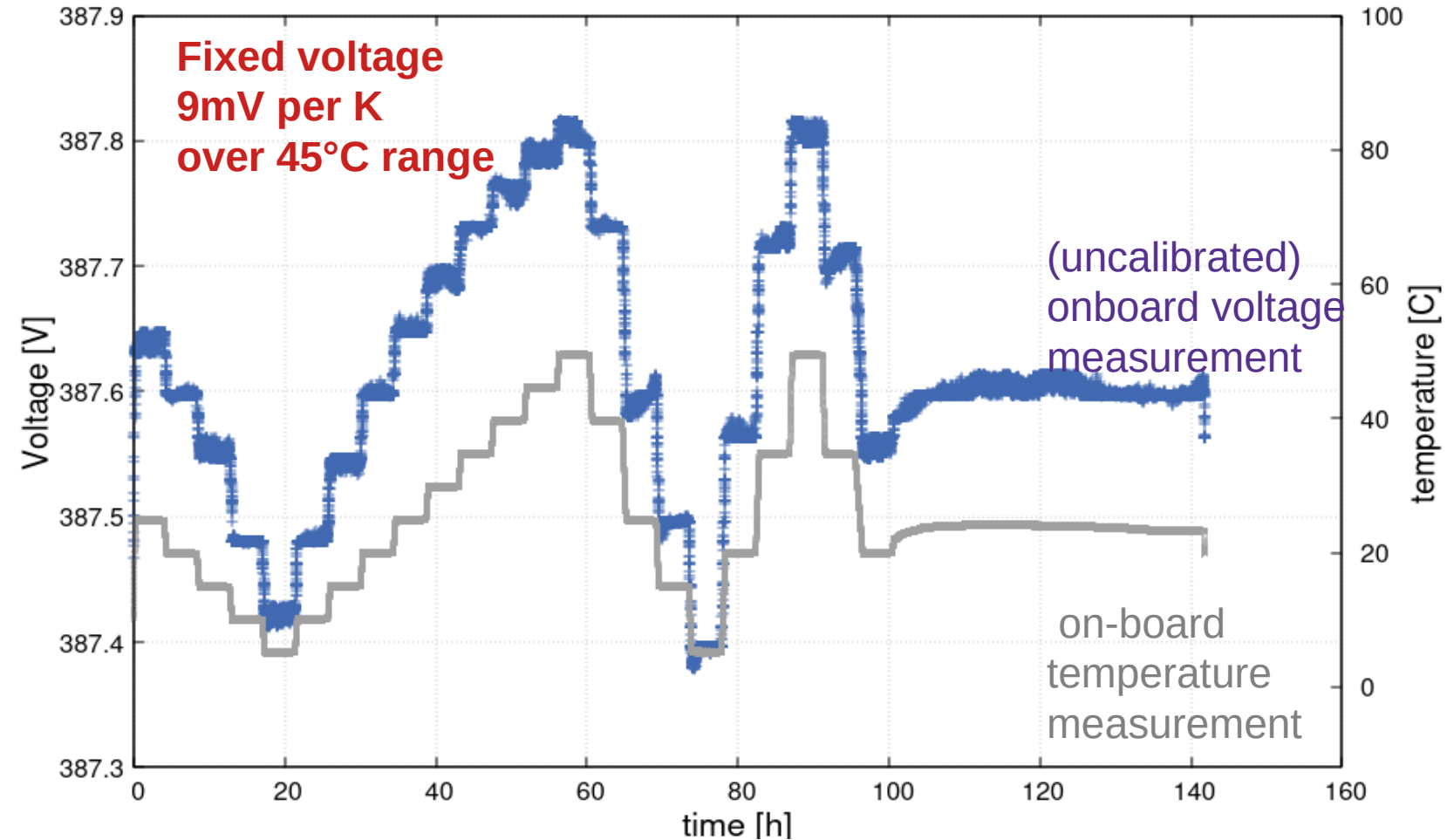
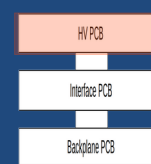




# High-Voltage Temperature Dependancy

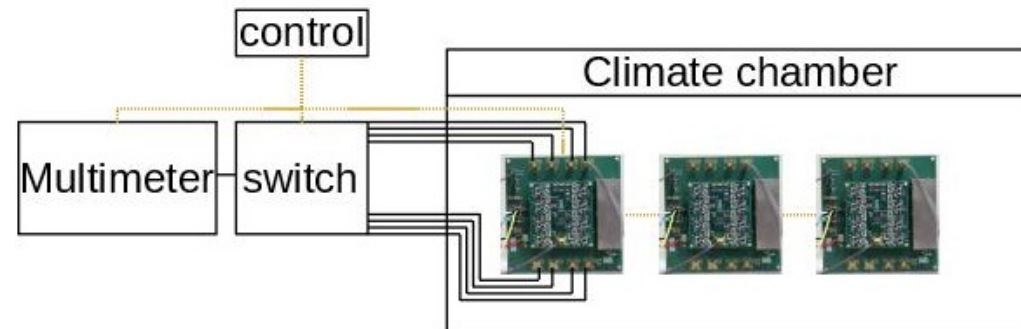
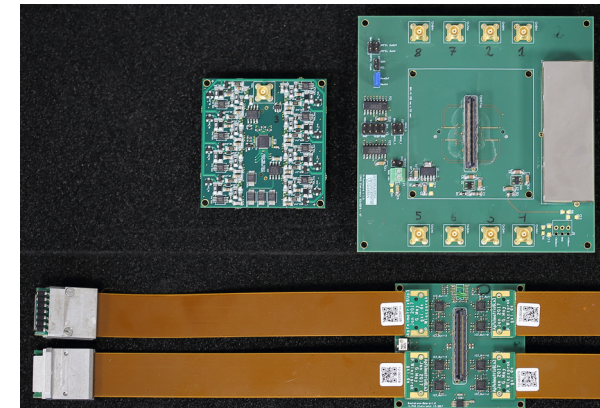


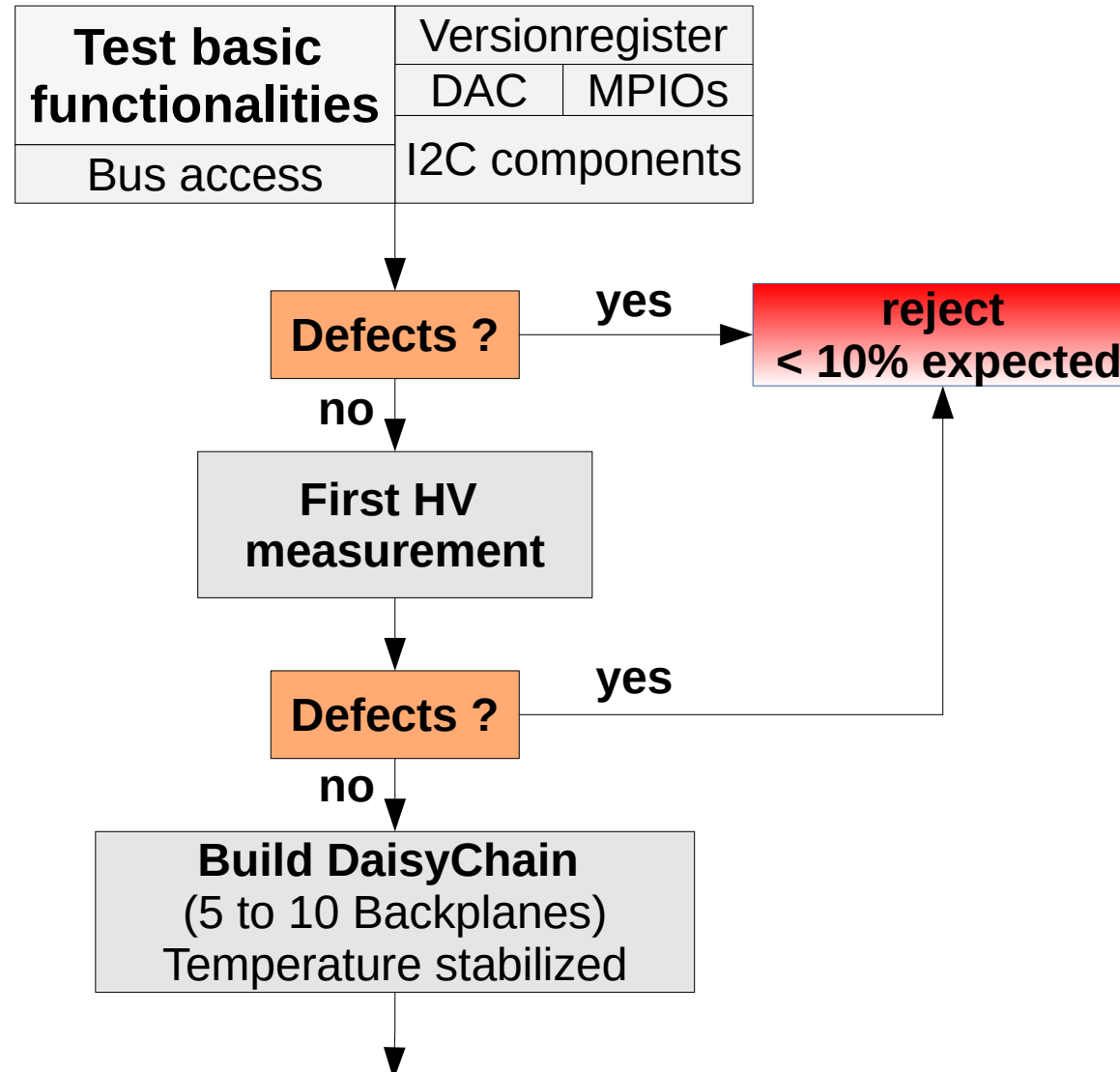
# High-Voltage Temperature Dependancy



## Which parameters should be taken into account for series tests and calibration?

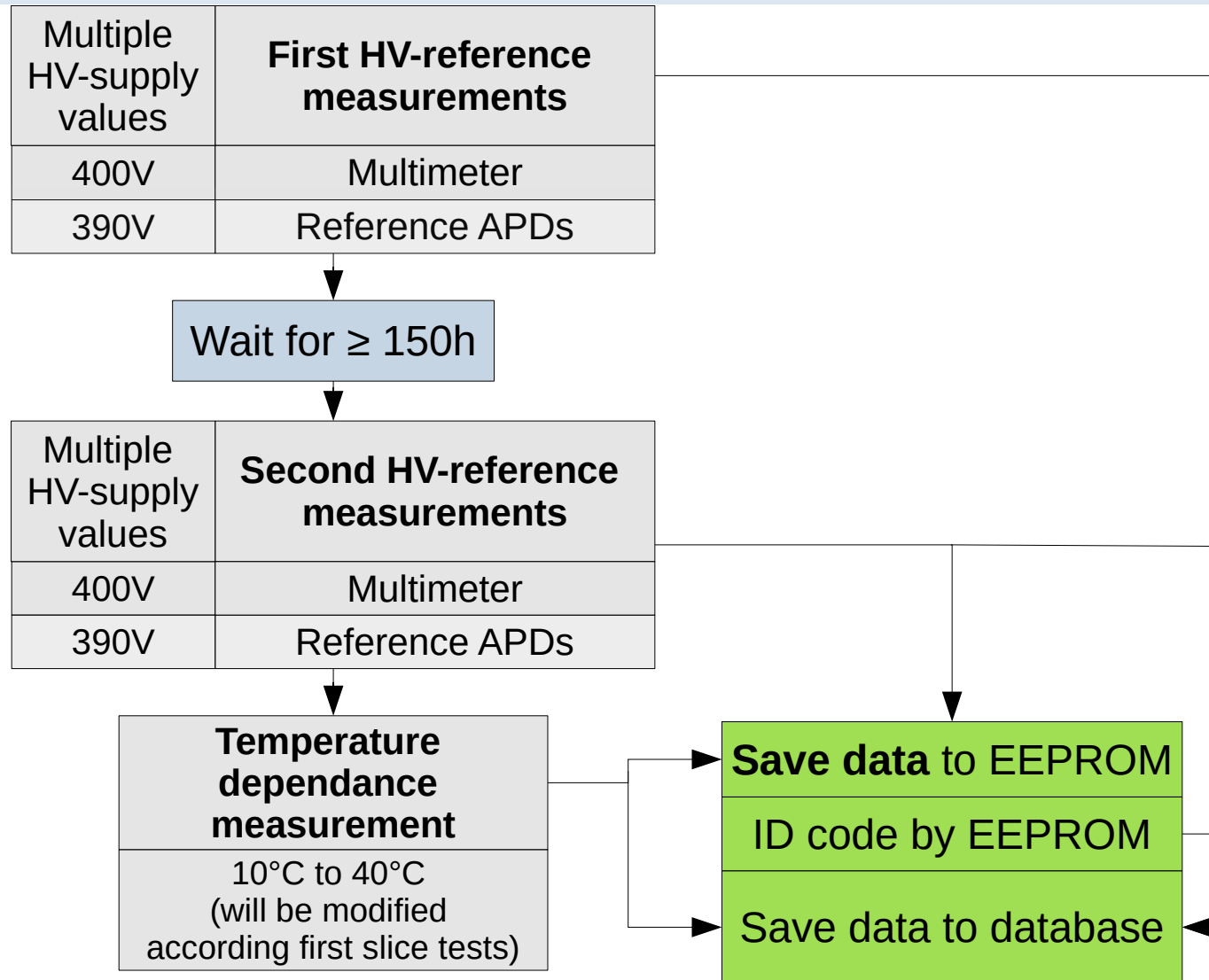
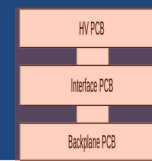
- Power consumption
- Basic functionalities work
  - bus systems
  - I2C components all functional
  - hv adjustability
- Switch-on behavior
- On-board ADC to external calibration measurement
- Temperature coefficients



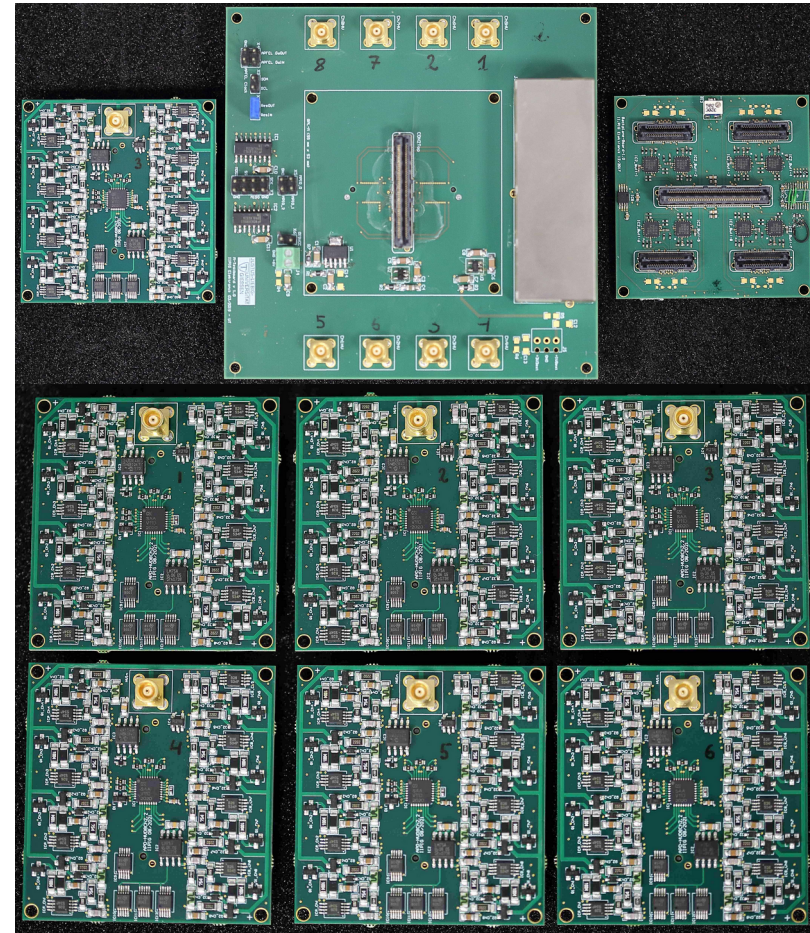




# Planned Calibration Algorithm



- **HV PCBs for first slice are in production**  
(expected any week by now)
- **First batch indicates no problems**  
→ slight deviations per PCB / single channels  
are observable as expected
- **Several observables and functionalities need to be taken into account for series calibration**
- **Test stand is in preparation**
- **Updated versions of Interface- and Backplane PCBs in production**



**Thank you  
for  
your attention**

