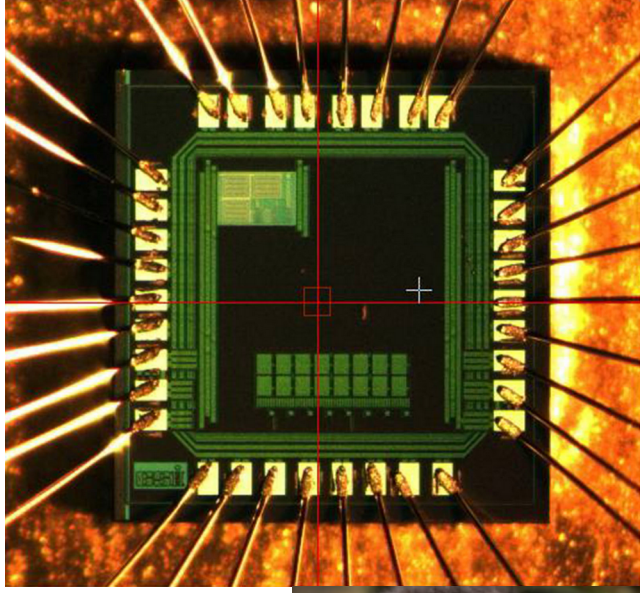
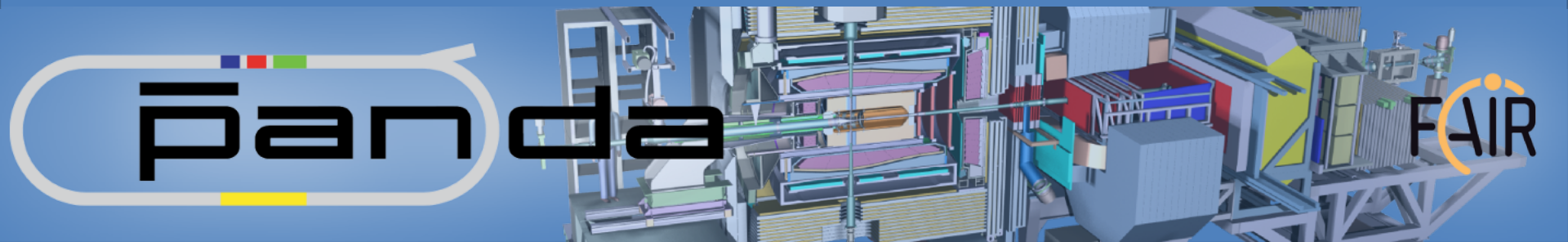
Barrel - Backplane electronics status update



Federal Ministry of Education and Research
JUSTUS-LIEBIG-UNIVERSITÄT GIESSEN
GSI

Christopher Hahn* for the PANDA collaboration
*2nd Physics Institute, University Giessen, Germany

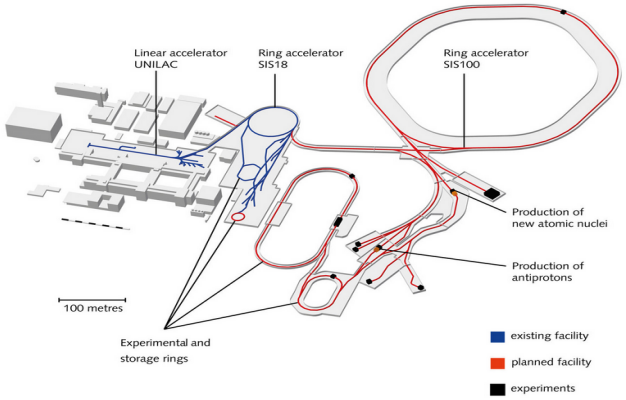
HIC for FAIR
Helmholtz International Center

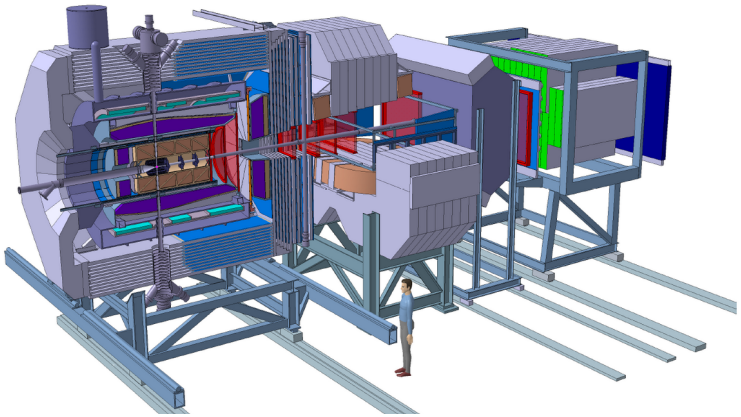


Outline

- **Overview**
- **Last prototype version of high-voltage board**
- **High-voltage measurements**
- **Detailed comparison between external and onboard measurements**
- **Proposed calibration algorithm**
- **Summary**

Motivation



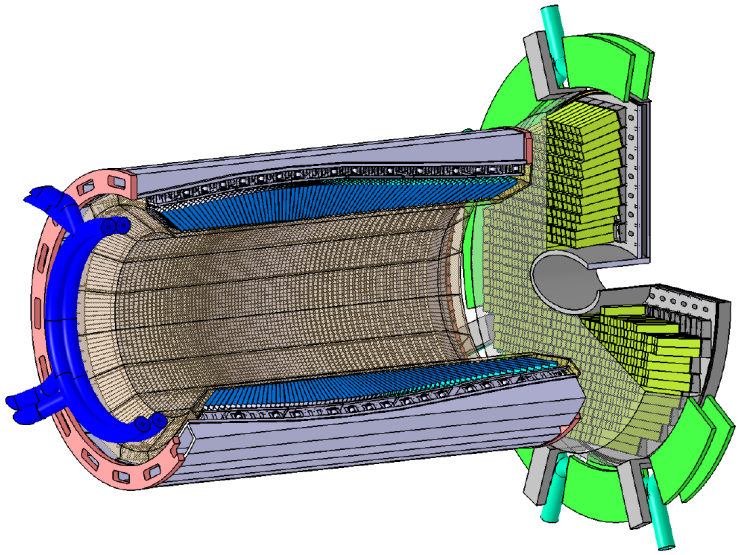


- 11200 PWO-II crystals in PANDA Barrel EMC (in 16 slices)
- 22400 large-area **a**valanche **p**hoto **d**iodes (APDs)

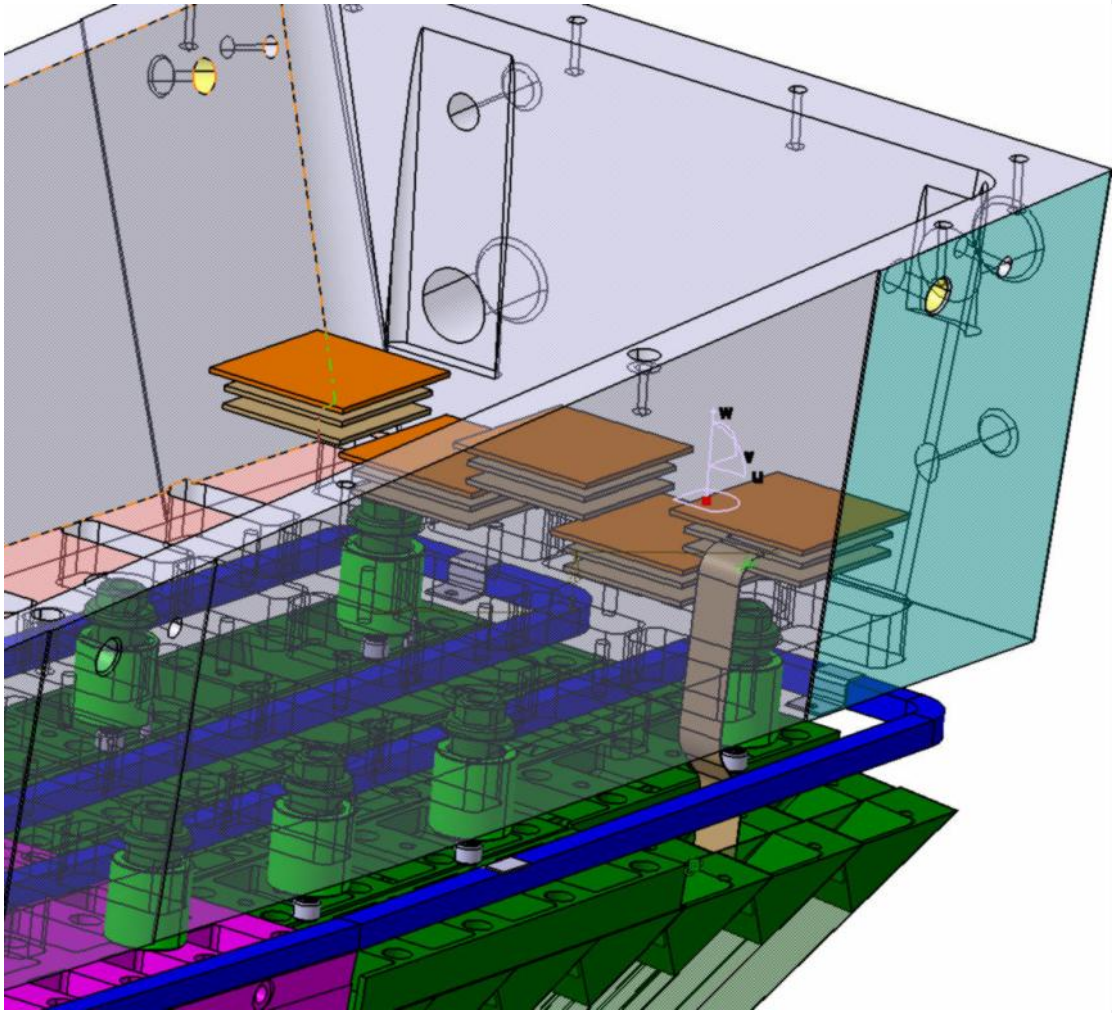
  → each APD needs individual adjustable high-voltage

  → one backplane supplies eight APDs

  → match in pairs and maybe octets

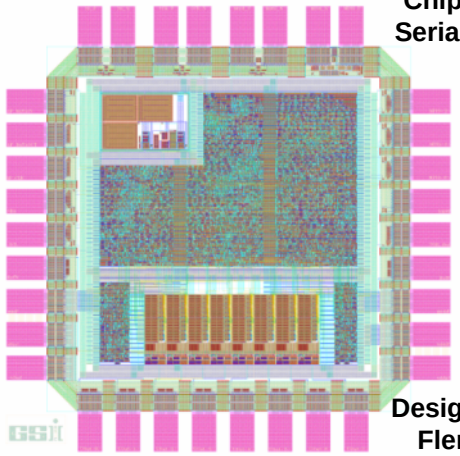


- **Tripple PCB setup**
  - HV distribution & regulation
  - Connector board for custom signal cables
  - Board for FlexPCBs / ASICs
    - Connectors to FEs
    - 8x2 Diff. Line drivers
    - APFEL I/F buffers
    - Temp/Humidity sensors



Motivation

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

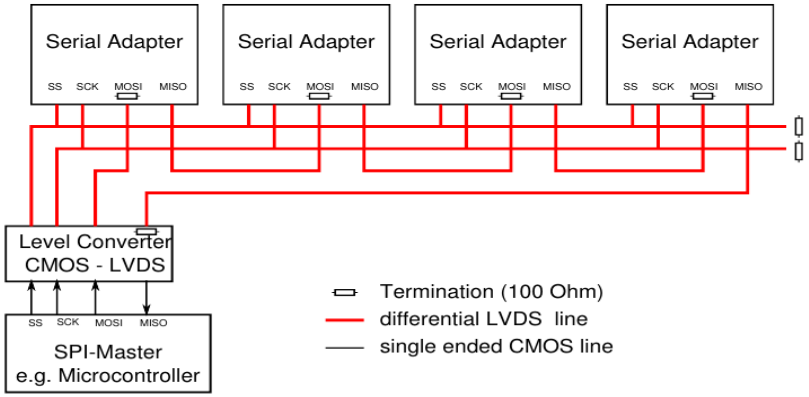


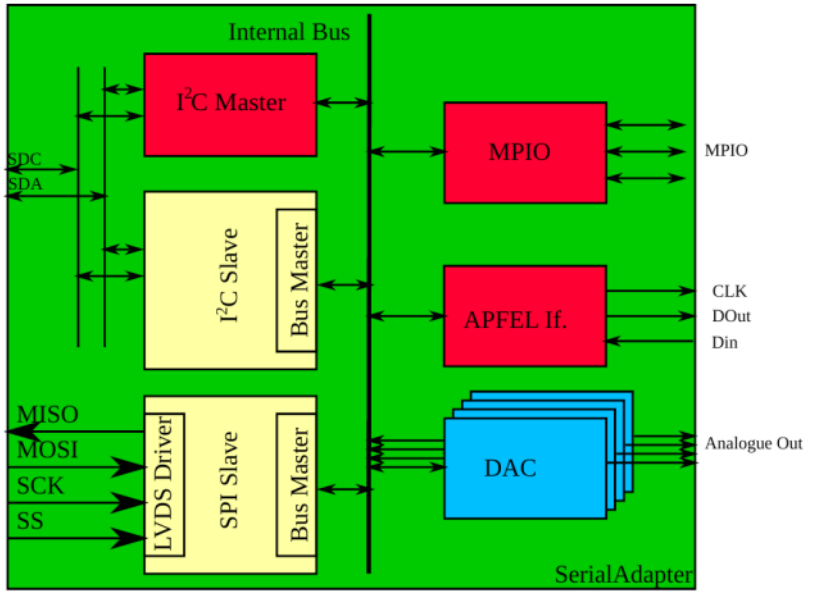
Chip layout of the SerialAdapter ASIC

1.5 × 1.5 mm Mini ASIC in UMC 180 nm CMOS technology

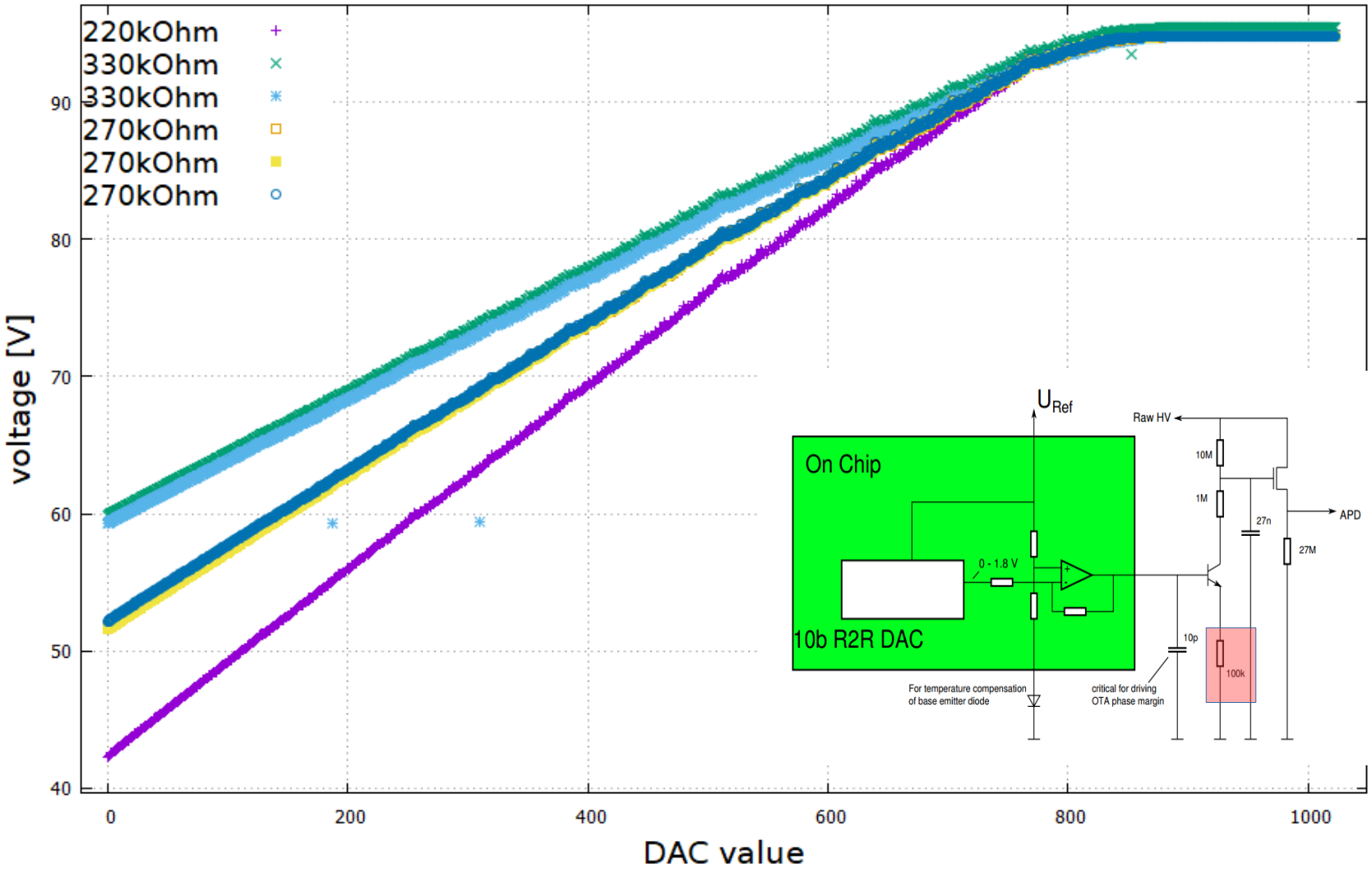
Designed by Holger Flemming (GSI)

Using a daisy chained SPI interface

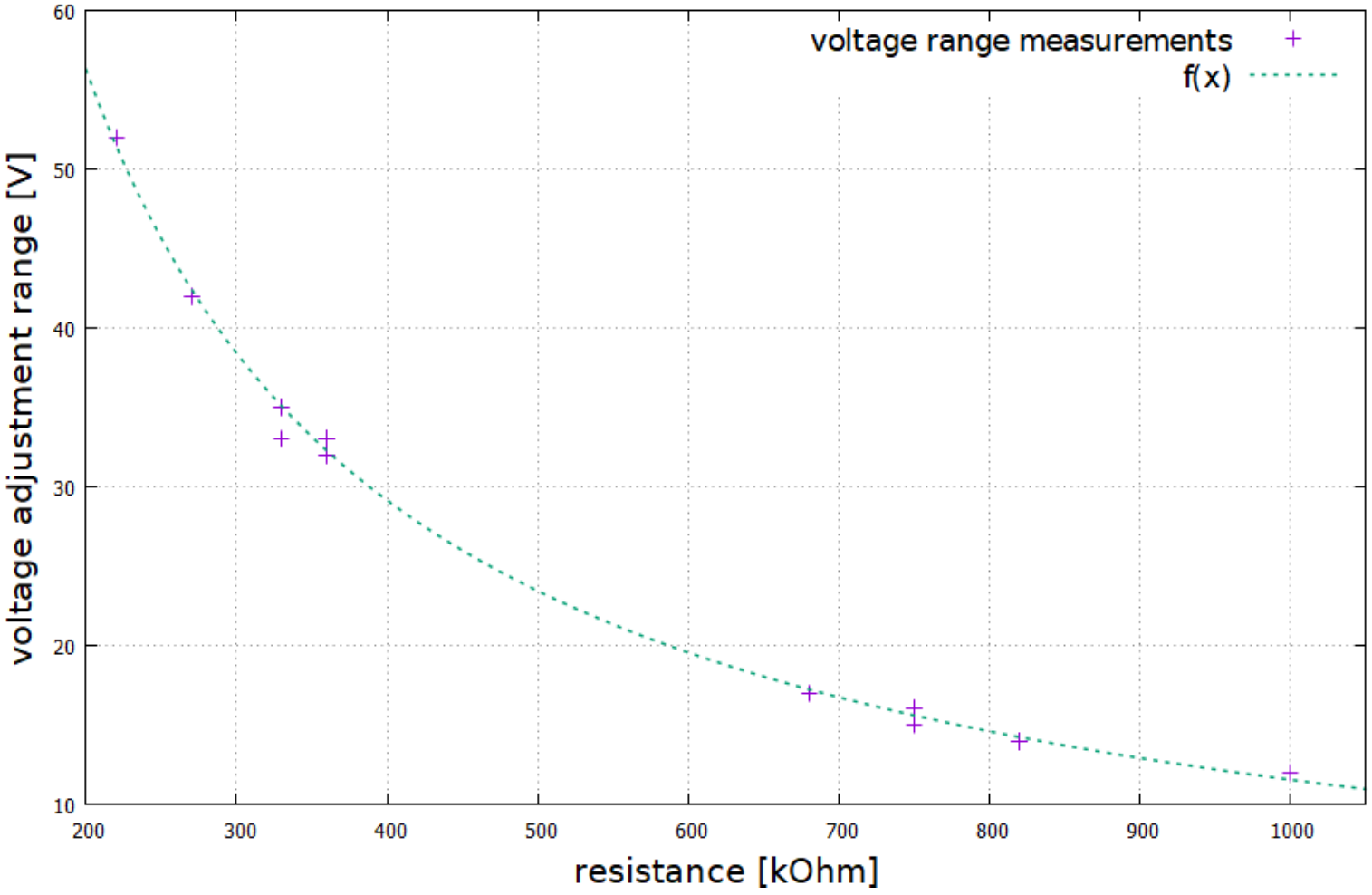




High-voltage measurements



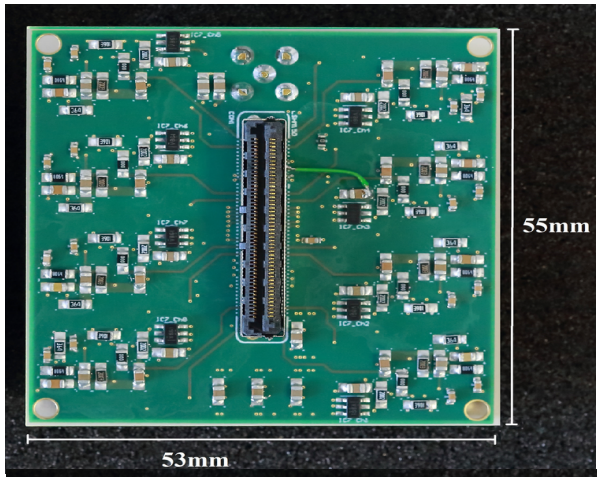
Adjustment resistor studies

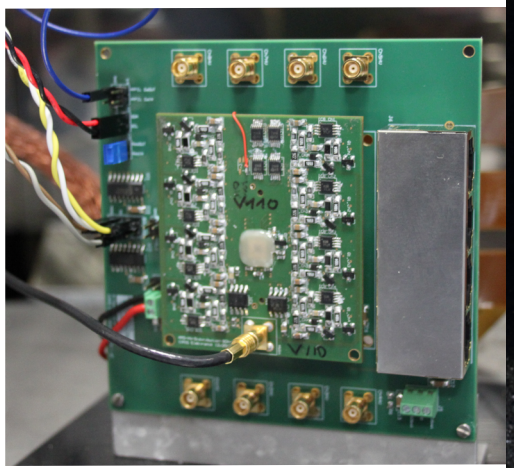


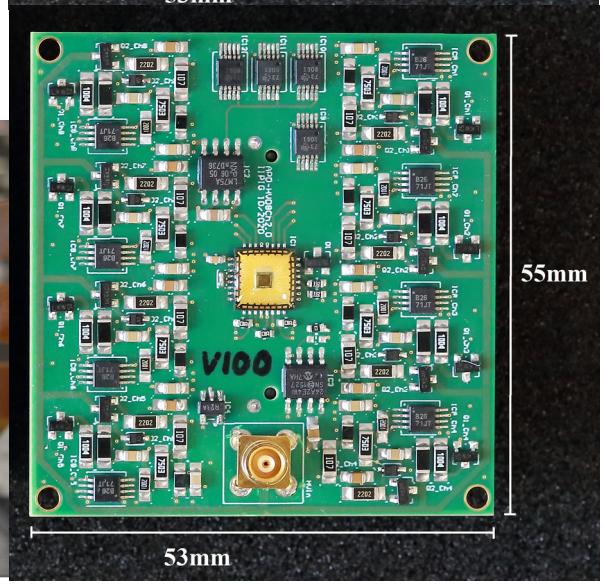
Last prototype version of HV Board

- Mass production of the SerialAdapter ASIC got delayed (190 are just enough for first slice with 5% safety margin)
- Final fixes and order of the PCBs for the HV control got delayed due to sick leave
  → Final Prototype is currently used for further tests
  → Software Interface is under rework

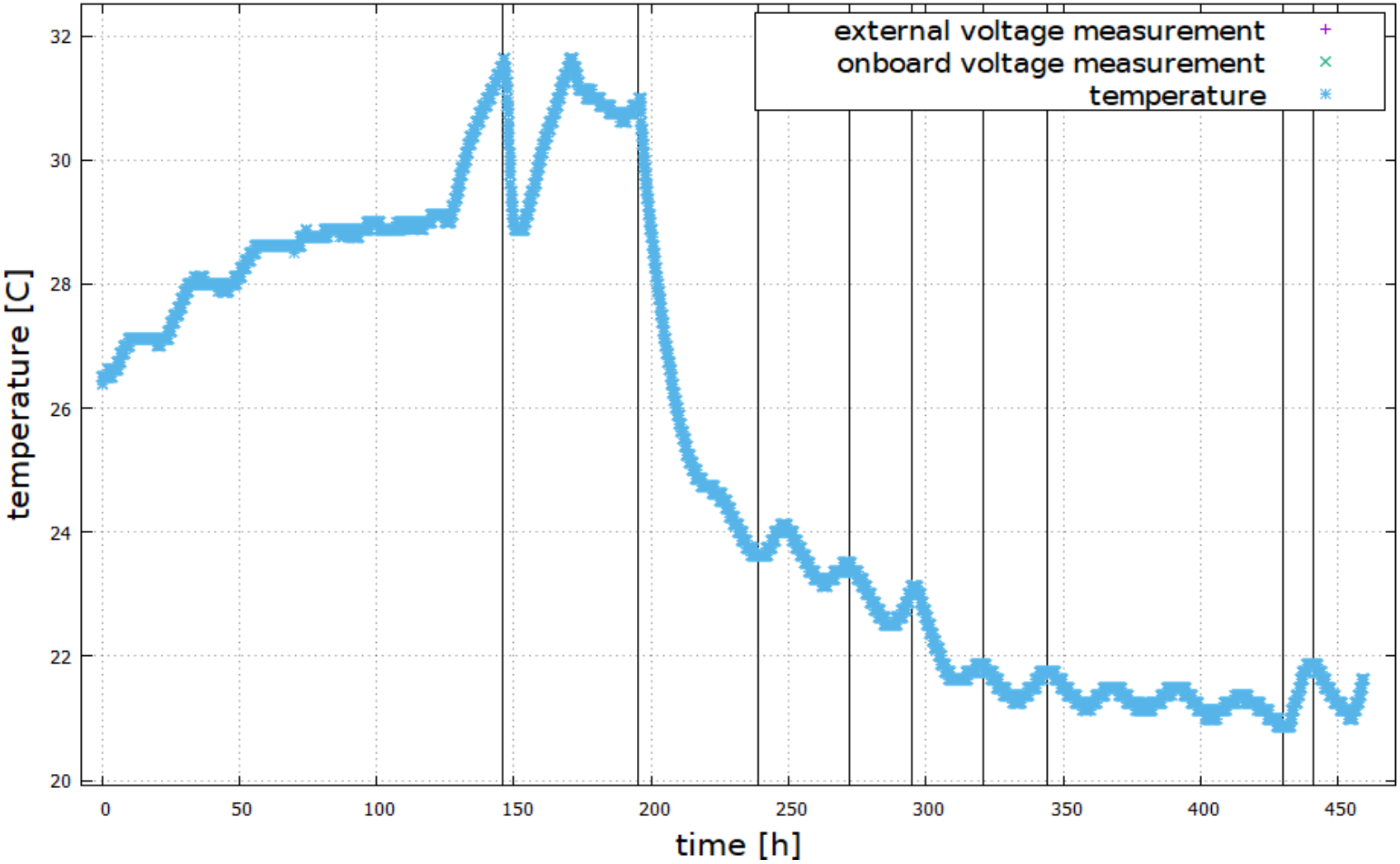
- Settled for a new voltage adjustment range
  34V → 16V
- New DAC setting correspondence
  37mV to 18mV



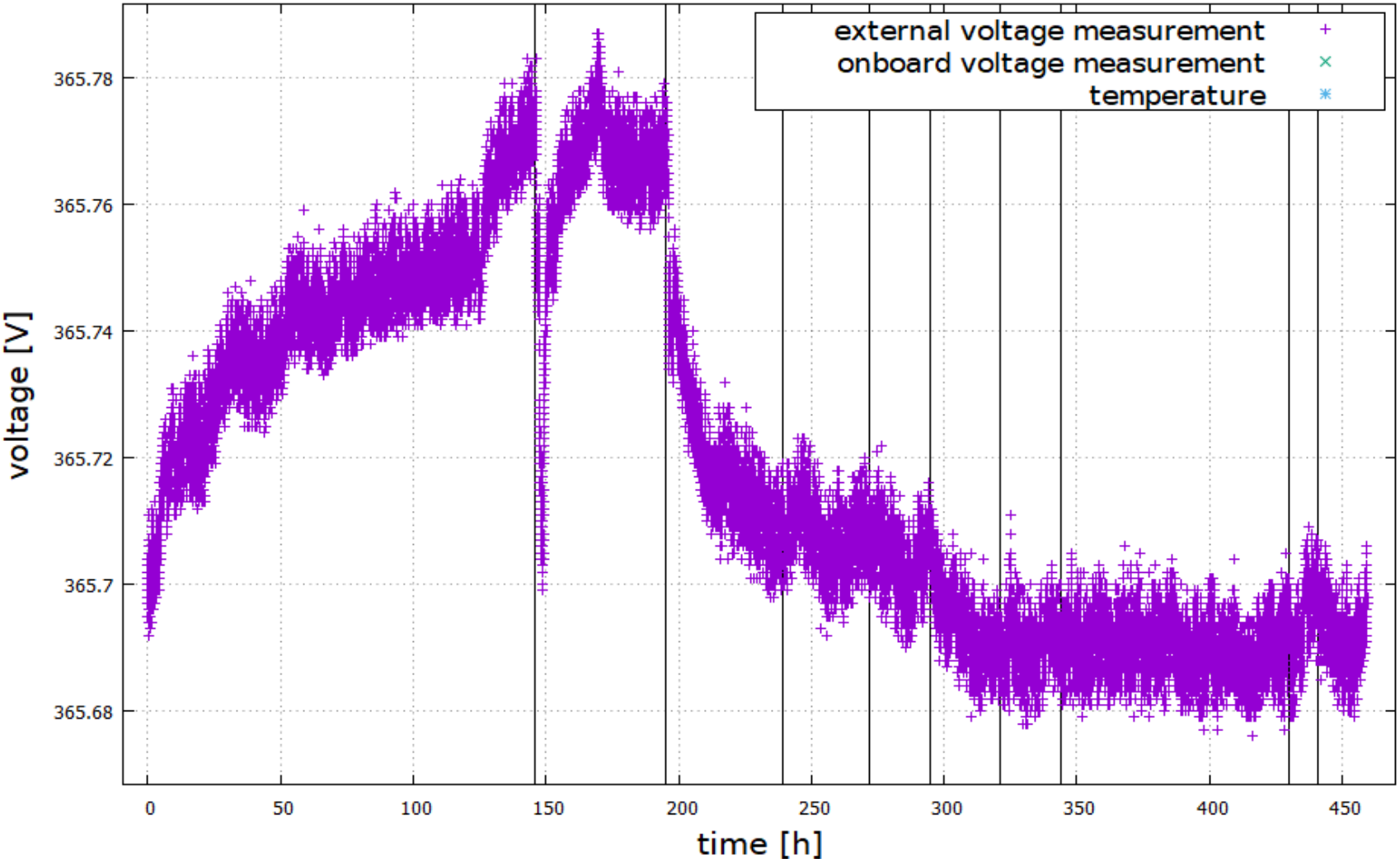




High-voltage measurements - room temperature



High-voltage measurements – room temperature



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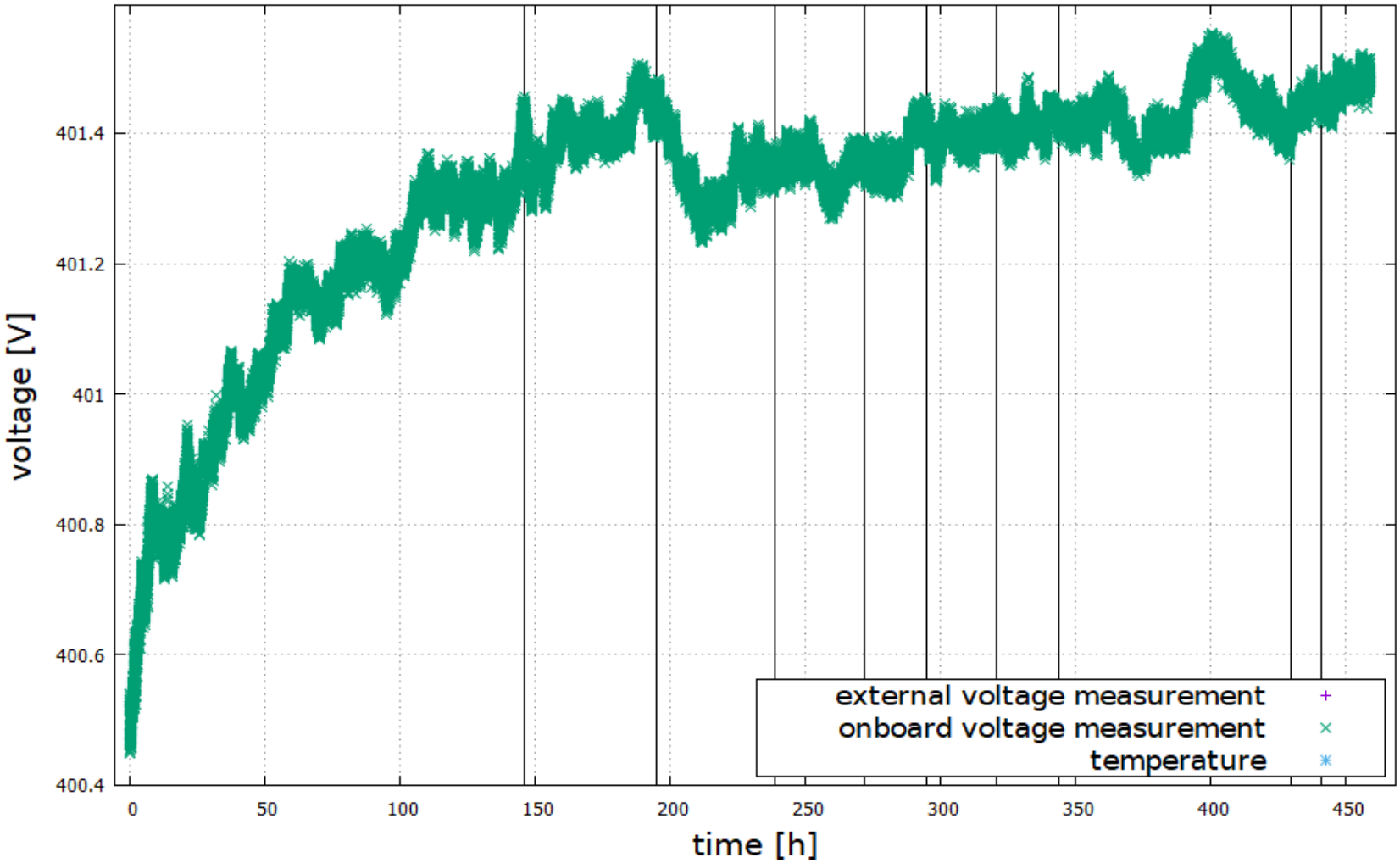
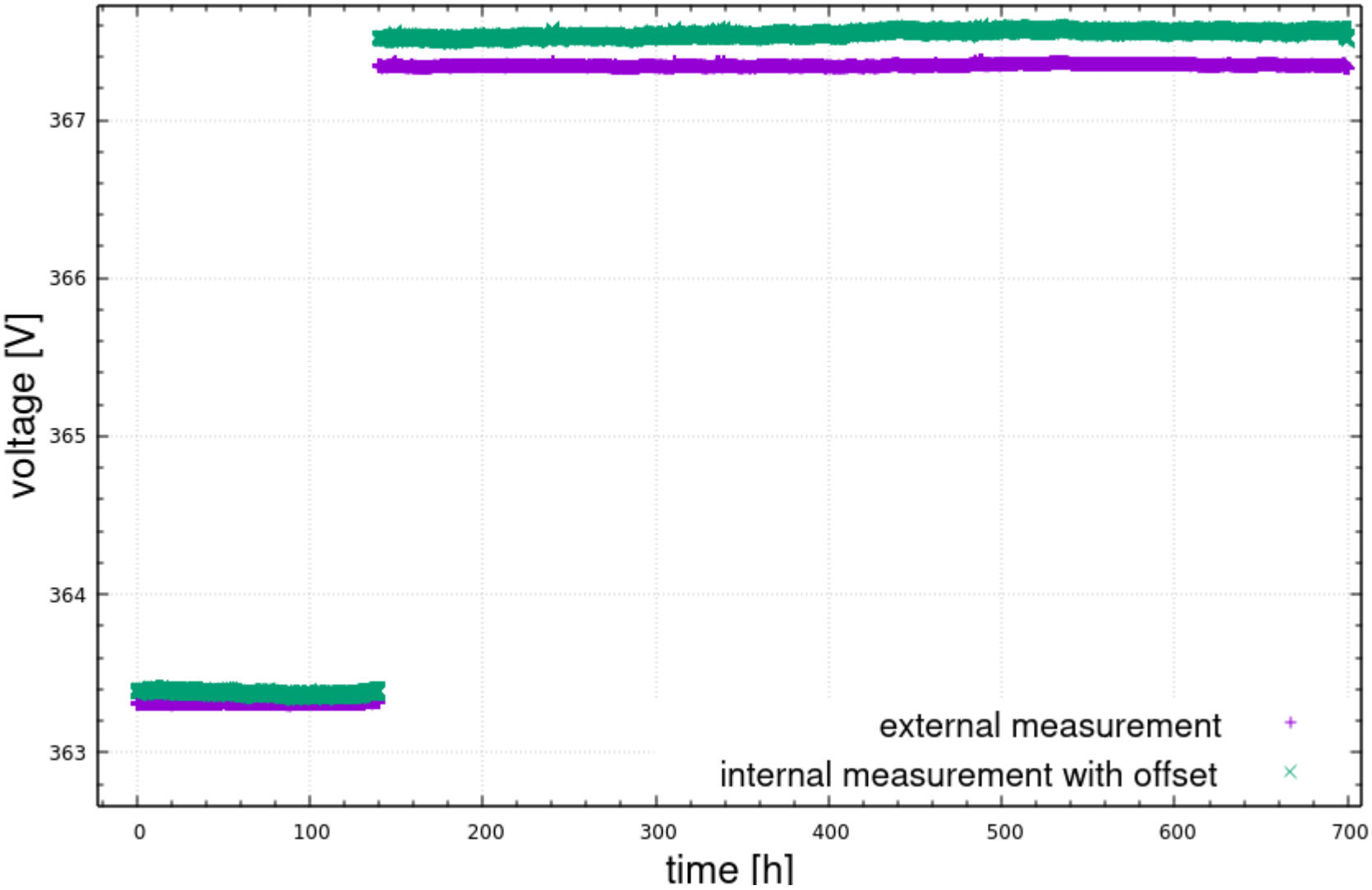


Detailed comparison between external and onboard measurements – temperature stabilized



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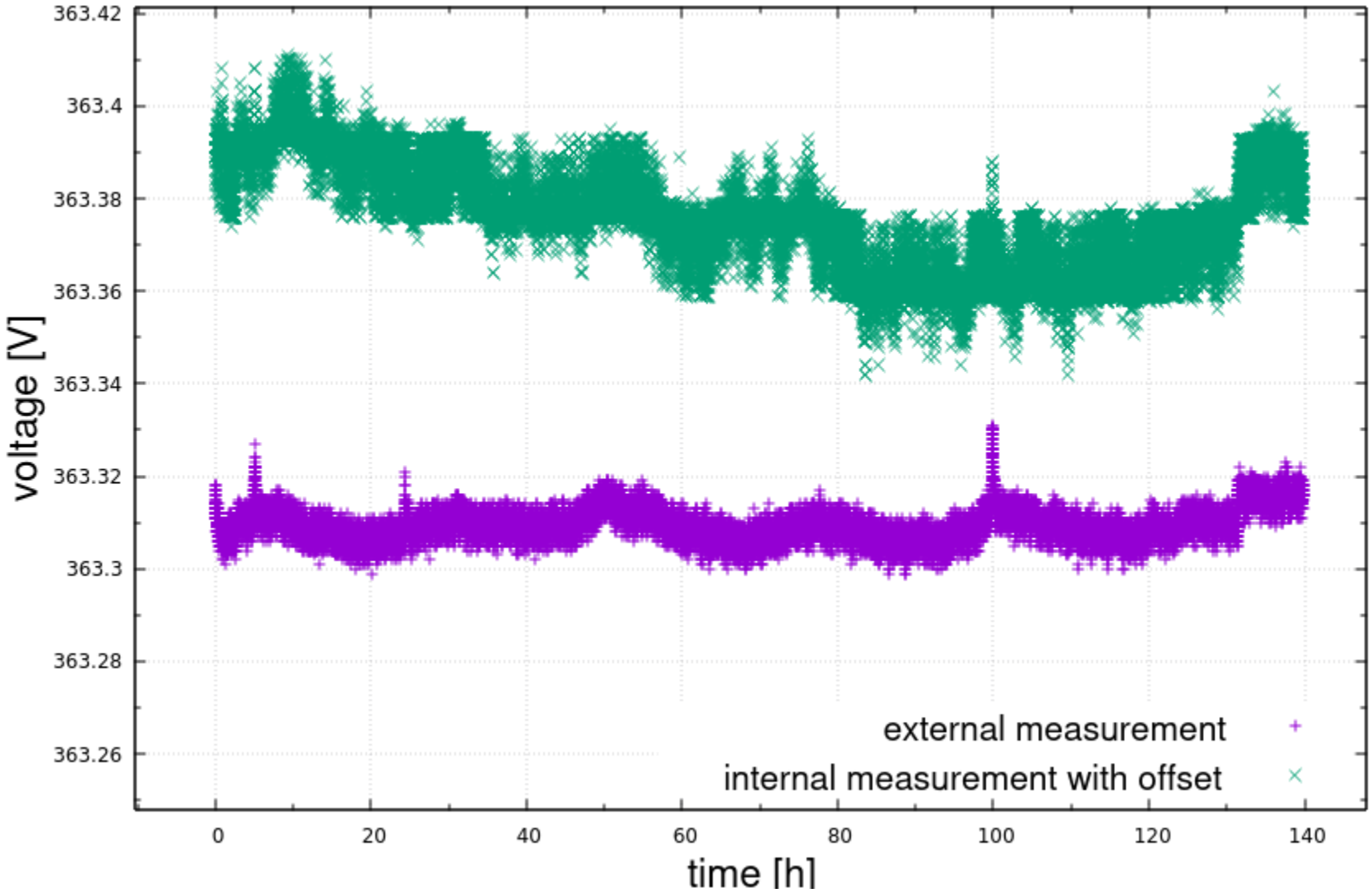

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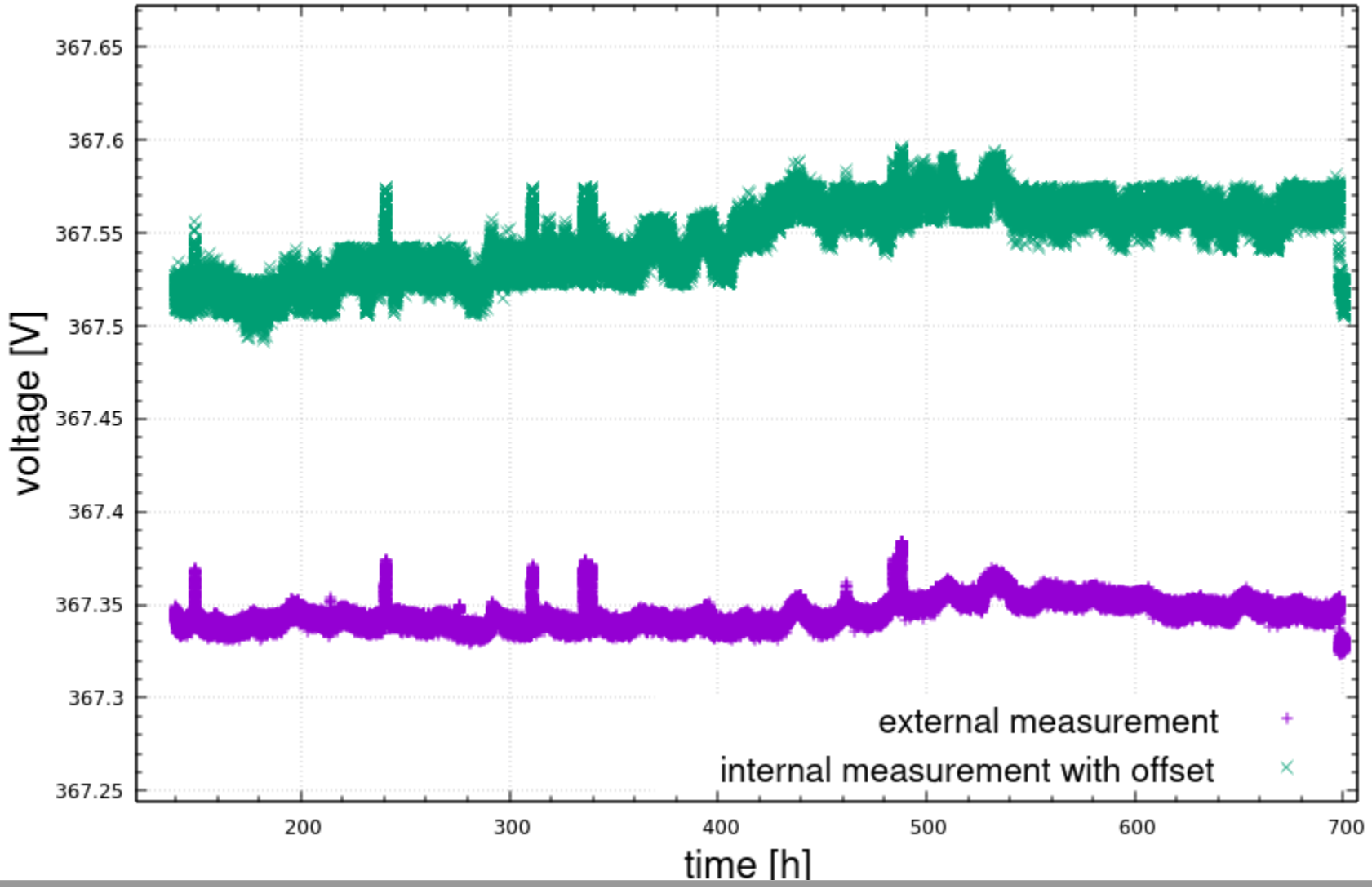

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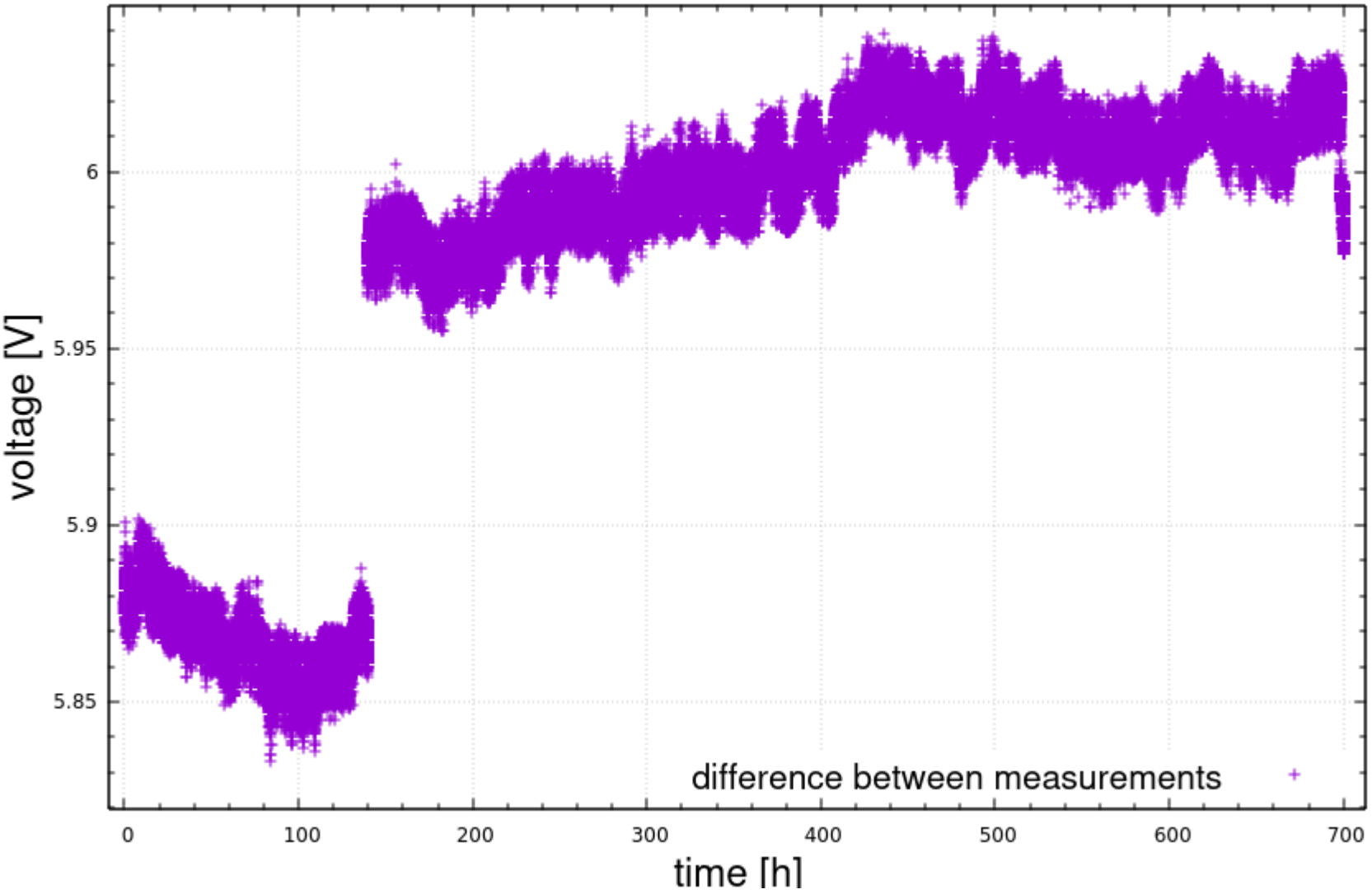
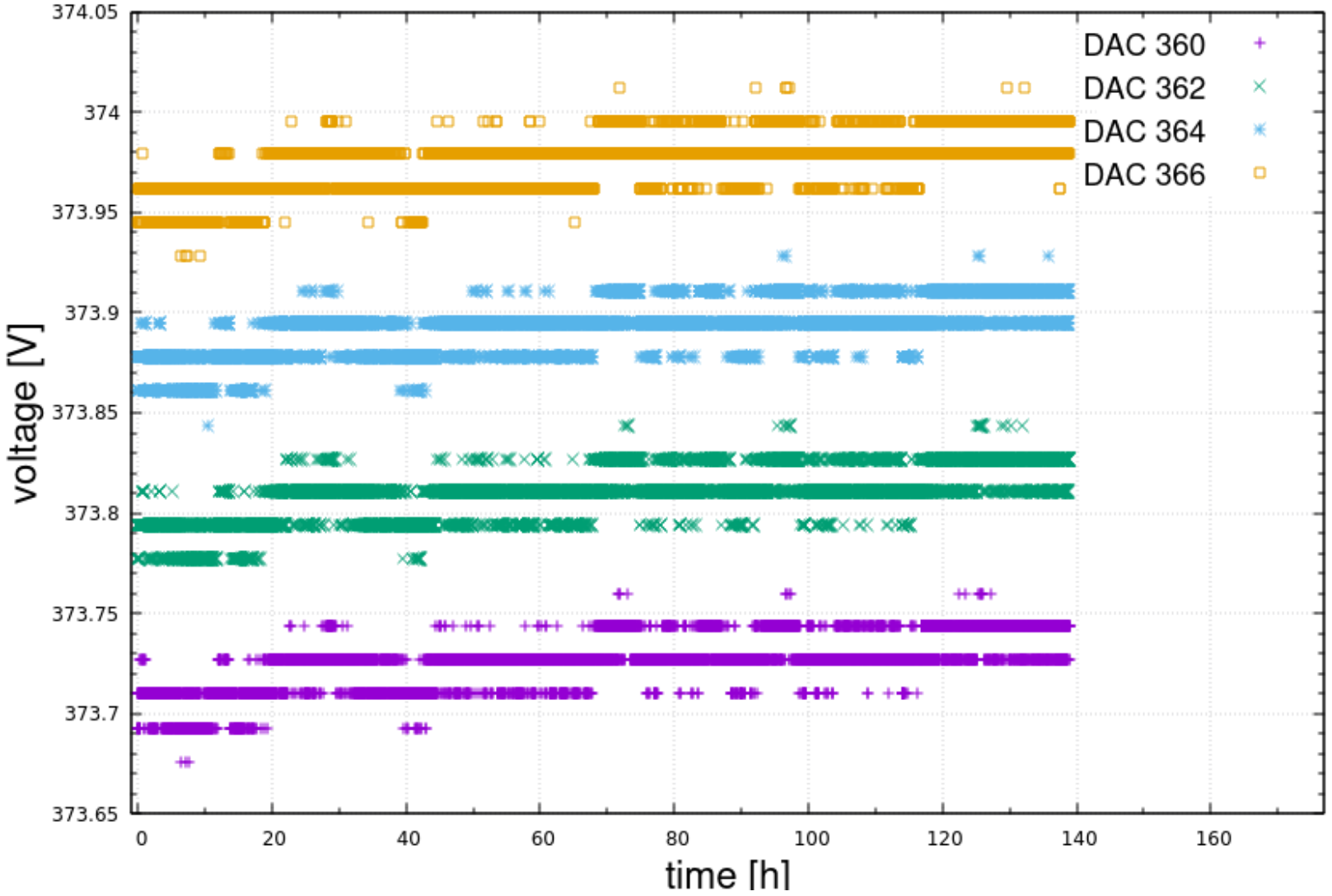


Simulation of DAC switching over time – temperature stabilized



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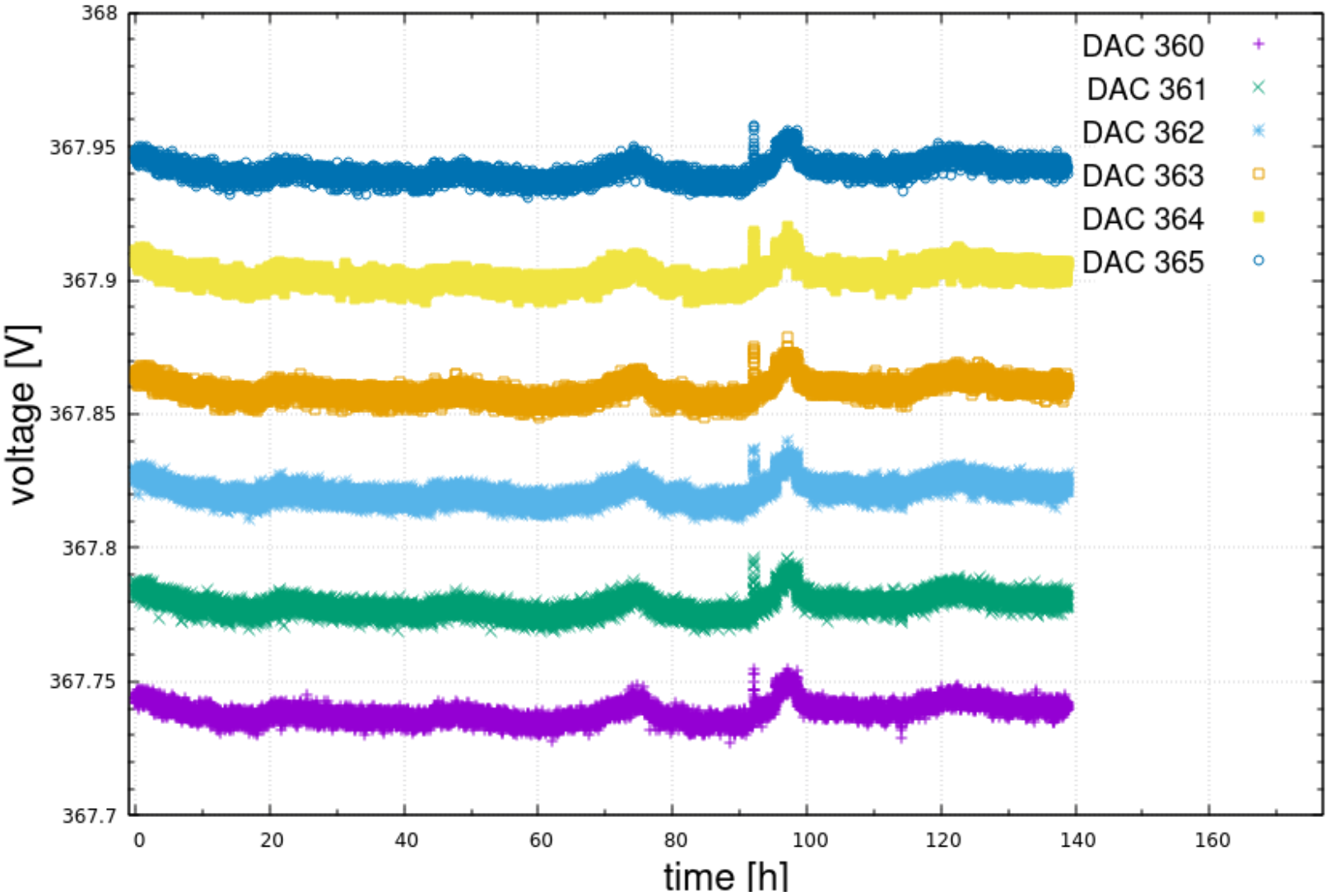
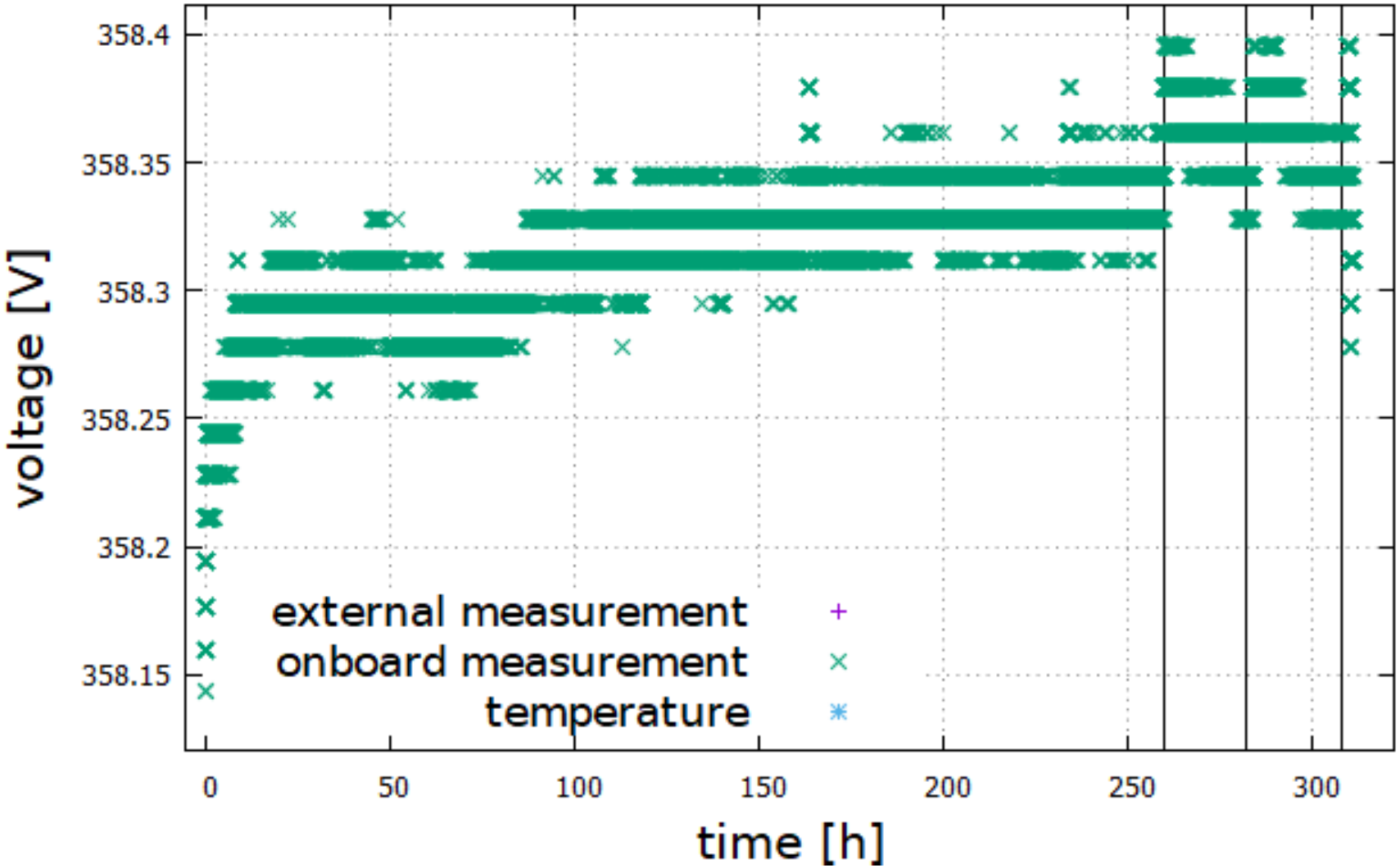
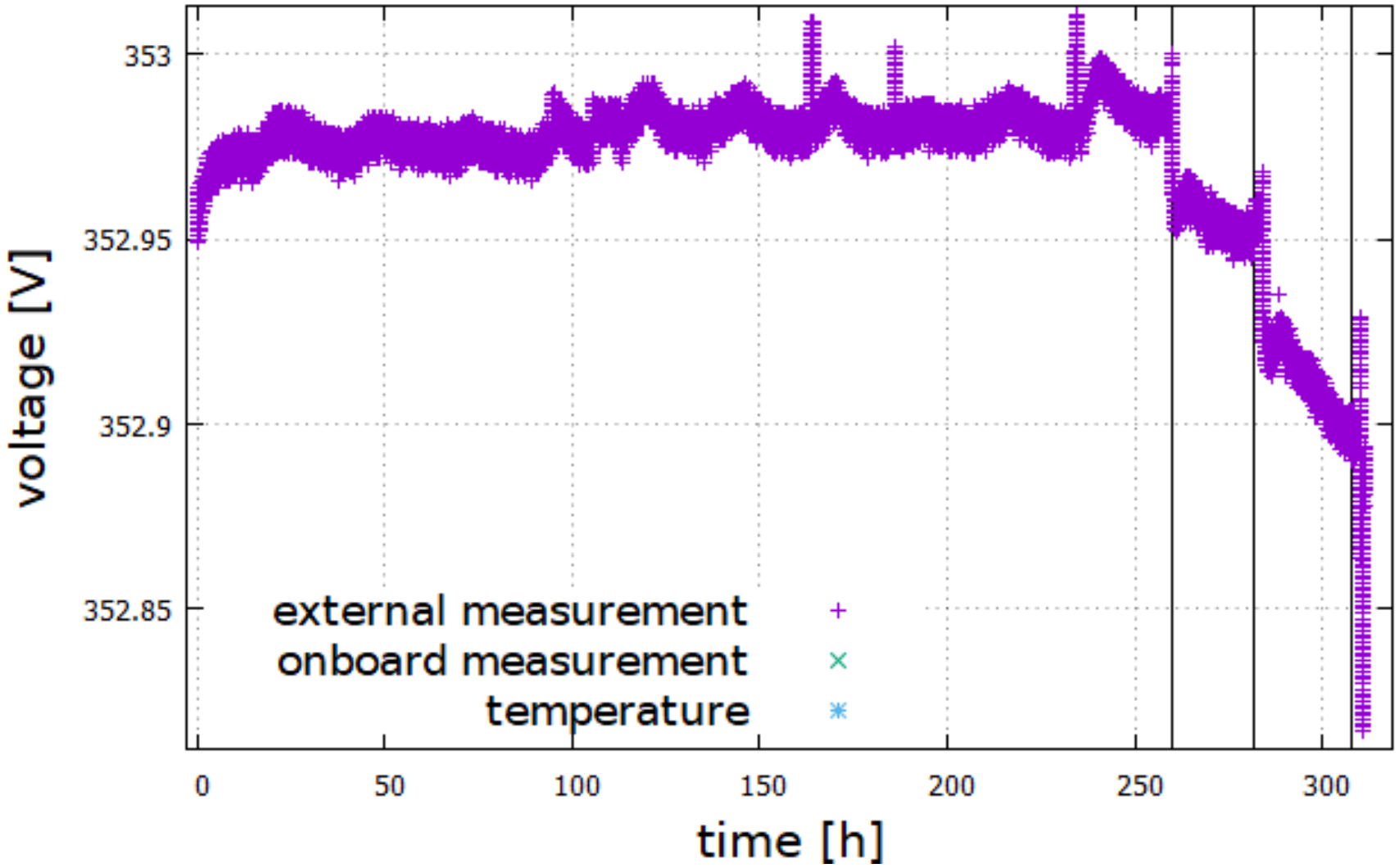


Detailed comparison between external and onboard measurements – temperature stabilized



Detailed comparison between external and onboard measurements – temperature stabilized



Detailed comparison between external and onboard measurements - interim conclusions

- **Drift of the onboard measurements due to dielectric absorption can be observed – only after swith on of primary HV**
- **Time constant of the drift in the order of 100h - 150h**
- **Temperature dependance measurements are necessary**

  → **change of high-voltage can be observed in direct measurement and onboard measurements**

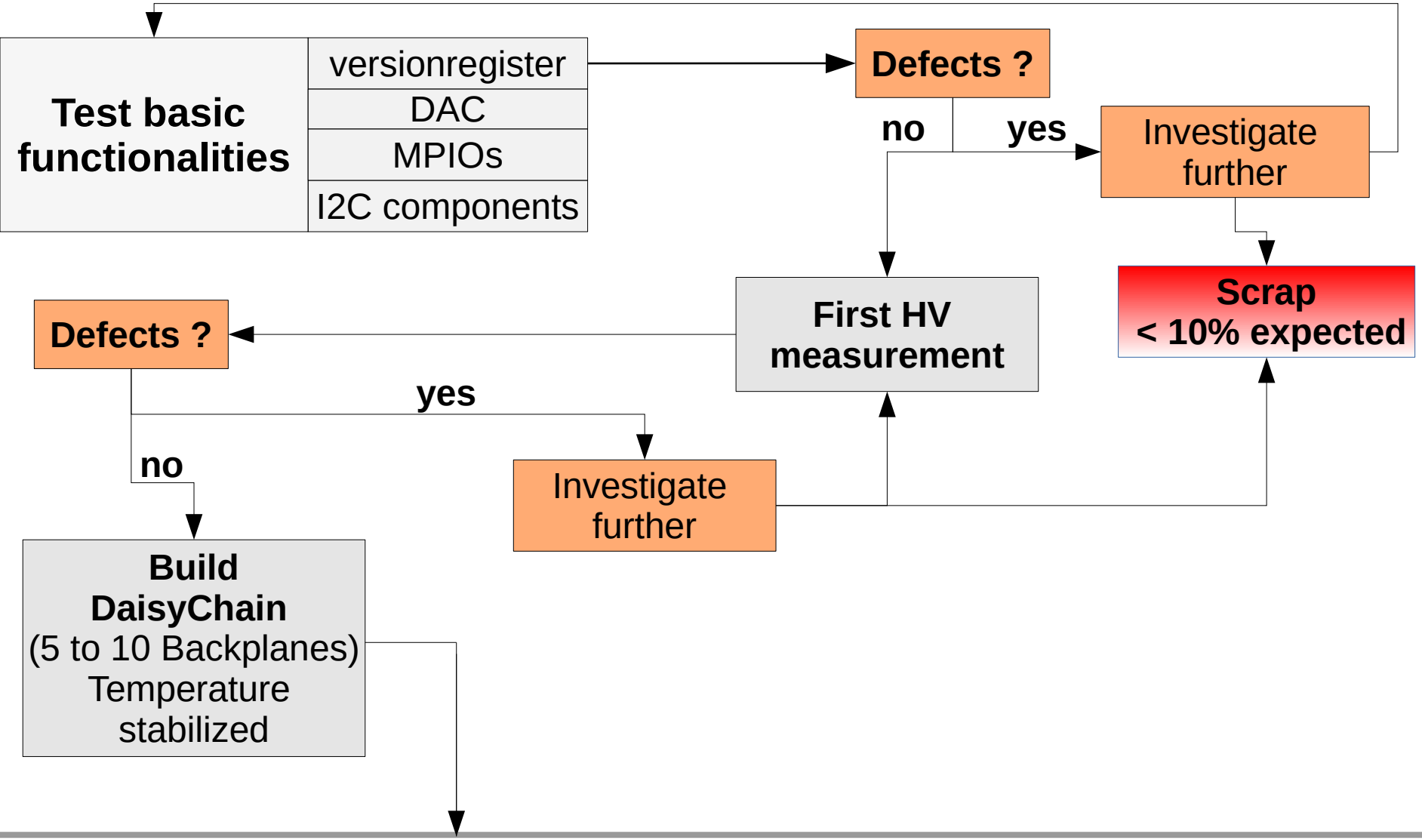
  → **at some point thermal equilibrium can be expected**
- **Some deviations between successive measurements of the ADS1115**

  → **iterate over several measurements to add statistics**

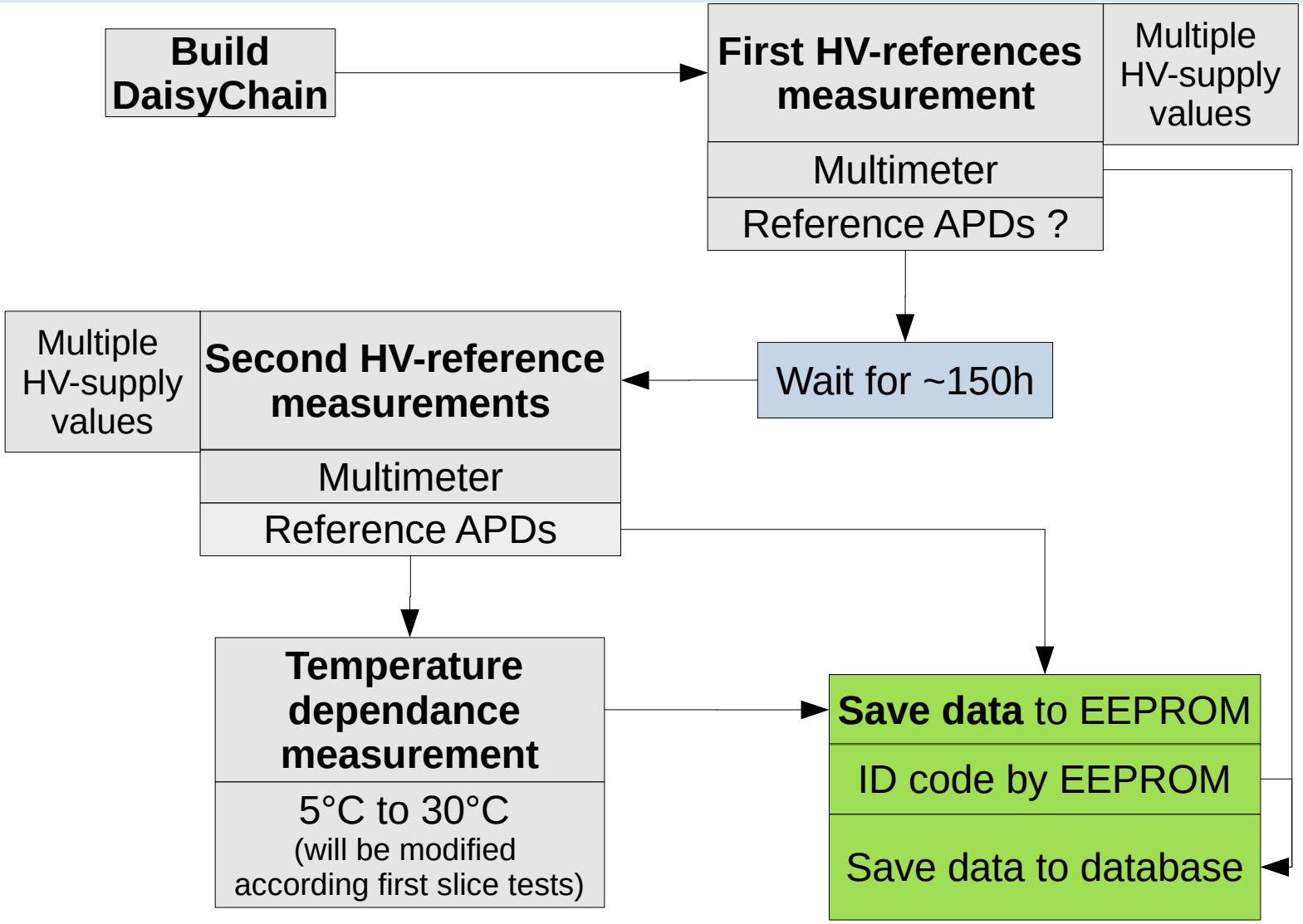
  → **external reference measurement necessary**

  → **fix DAC setting to HV output**

Proposed Calibration algorithm



Proposed Calibration algorithm



Summary

- **Final Prototype is currently used for further tests**
- **Software Interface is under rework**
- **Calibration and test environment is forseen to be installed within the year**
- **Known behaviour of HV-PCB gets condensed into calibration algorithm**
- **HV-PCBs for the first slice are ordered**
- **Mass production of the SerialAdapter ASIC got delayed (190 are just enough for first slice with 5% safety margin)**
- **Most active components have been purchased**
- **Some adjustments to passive components were made → passive components are ordered**
- **Currently in contact with assemblers**