The new generation of iseg HV power supplies: Usage studies for test stand and experiment

Tobias Triffterer

Experimentelle Hadronenphysik
Ruhr-Universität Bochum

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The Problem

- Follow-up to my talk in the EMC session at the LVIII. CM last September in Mainz
- Talk available in Indico and the DCS wiki talks archive

- iseg HV modules could not regulate voltage properly any more
- Deviations became worse over time
- Modules started to become unusable for APD screening
- Delayed and disrupted work on the Forward Endcap EMC

$\Rightarrow$ Send old modules to iseg for repair and recalibration
$\Rightarrow$ Get some new modules with new hardware from iseg

Introduction
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Problems with Old Modules
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Results for New Modules
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Discussion
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## Background Information and Definitions

- Old modules were produced in 2008
- iseg redesigned hardware in the meantime
- Distinguishable by serial number:
  6 digits $\Rightarrow$ old, 7 digits $\Rightarrow$ new

- Measurand for many plots in this talk: $V_{\text{diff}} = V_{\text{mom}} - V_{\text{set}}$
- x axes in all plots: Time since start of measurement in seconds

- Two usage scenarios for iseg HV modules at Bochum:
  - APD screening: Increase voltage from $0\,\text{V}$ to V_{break} in small steps and record data at every step.
  - Detector test: Run at a single voltage value which has to remain constant for a long time.
- VPTTs less sensitive to HV fluctuations than APDs

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Module 720060 before repair
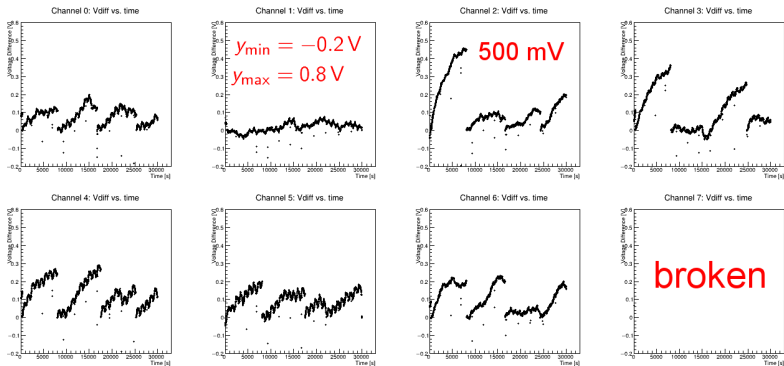
- Old 1 kV high-precision module, 8 channels
- Simulated APD screening
- Reproduction of this test yielded similar results

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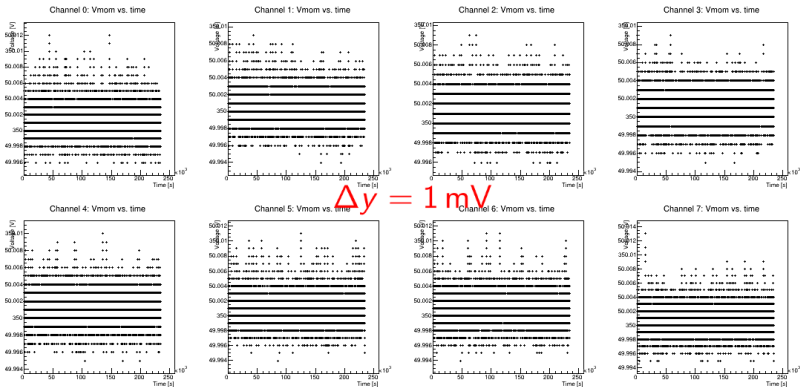Discussion
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Module 720060 after Repair
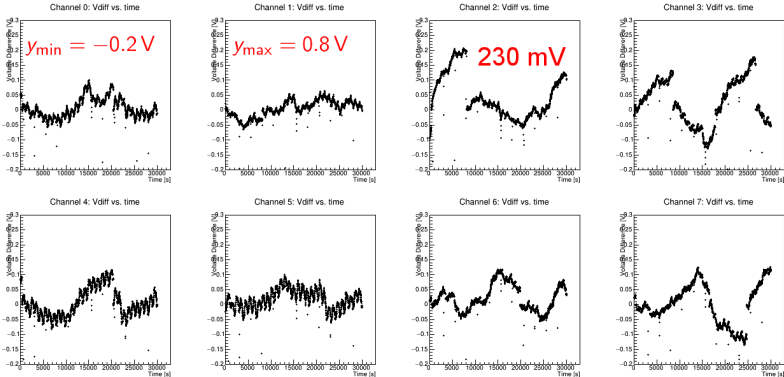
- Module sent to iseg for repair and recalibration (340 €)
- Repeated measurement after return
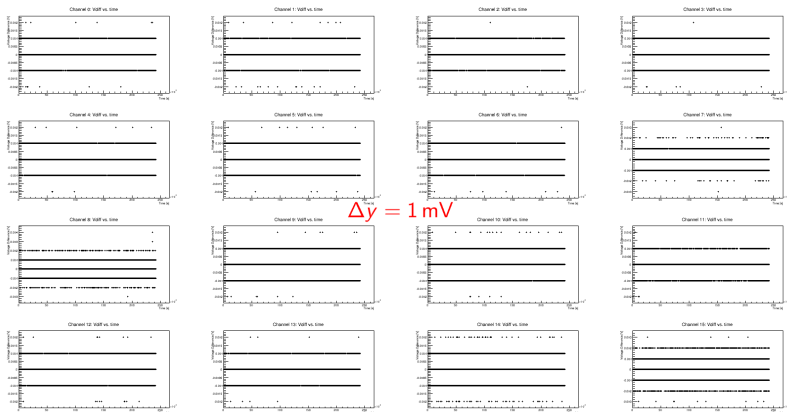
Module 720060 Comparision before/after
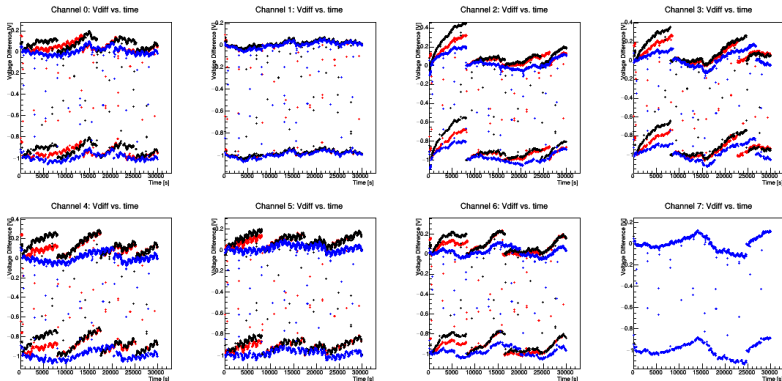
- Black and red: Measurements before repair
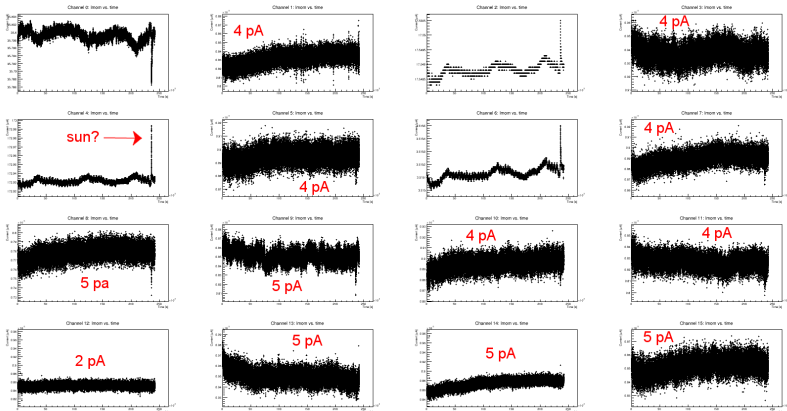- Blue: Measurement after repair

Module 720060 Detector Test

- Simulated detector operation at $V_{set} = 350\,V$
- Measured after repair and recalibration
- Fluctuations up to $20\,mV$

Module 7200017 Voltage Stability

$\Delta y = 1\,\mathrm{mV}$
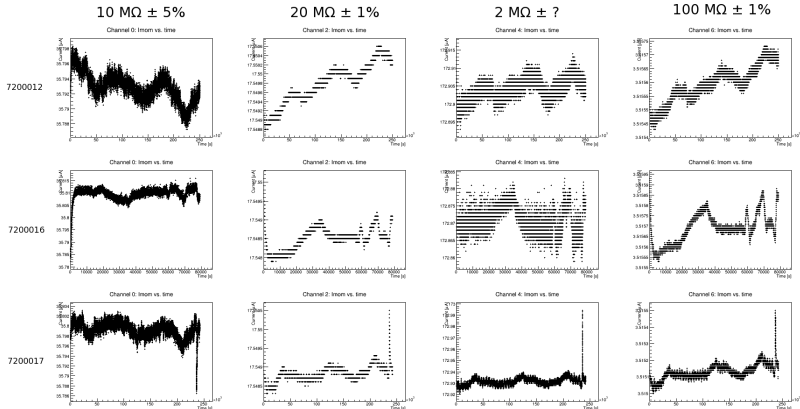
- Same simulation with new module ($V_{\mathrm{set}} = 350\,\mathrm{V}$)
- 241 959 samples (67.2 h) in total, deviations of 2 mV in 7295, 3 mV in 91 and 4 mV in 5 samples

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Module 7200017 Current Stability

- Ohmic resistors on channels 0, 2, 4, and 6
- Open SHV connector on all other channels

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Variations under Ohmic Load

- Fluctuations seem to be caused by resistors (temperature?) and not by HV modules

Using new Modules for APD Screening
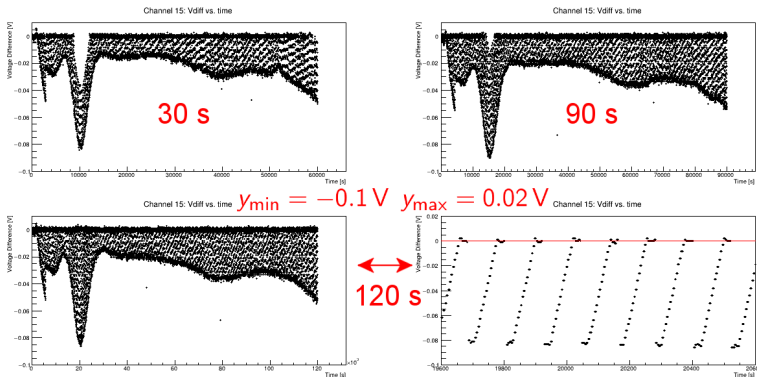
- Time between voltage steps matters
- Module always reaches V_{set} within $1\,\text{mV}$ to $2\,\text{mV}$, but may take up to $120\,\text{s}$

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Evaluation of Results

- New module generation significant improvement
- Delay of measurements due to long regulation cycle annoying but manageable
- If the performance of the new modules does not decay over time (employing regular recalibration if necessary) they are suitable for $\overline{\text{P}}$ANDA

- APD and unit teststands in Bochum switched to new modules last Thursday (2$^{\text{nd}}$ March)
- Improved readout software (new EPICS device support) in operation
- APD screening should be faster and more precise now

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Questions for the EMC

- Most FE modules are currently stored in Basel. How many of them are "new" modules?

- All old modules in Bochum need recalibration
- Results (see September talk) show that even unused old modules need recalibration, too
- Many have broken channels or other defects
- ⇒ How do we pay for the repairs (last time 340 € per module)?

- Should we (partially) replace old modules with new ones?

- How do we handle the recalibration requirement when $\overline{P}ANDA$ is in operation?

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Unrelated Topic: Importation Sales Tax

- HV modules bought by Basel must be shipped to Germany
- They can be exempted from customs duty as scientific equipment according to articles 44 to 51 ZollbefreiungsVO[1]
- Scientific equipment **cannot** be exempted from German Importation sales tax (19 %) according to §1 (1) EUStBV[2]
- Customs is governed by EU law, sales tax by national law
- FAIR has special status (art. 7 FAIR Convention)
- Bureaucratic procedures for five "test" modules have begun
- If you want to ship equipment to Germany, contact $\overline{\text{P}}$ANDA RC Ralph Böhm in time

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[1]Council Regulation (EC) No 1186/2009 of 16 November 2009 setting up a Community system of reliefs from customs duty

[2]Einfuhrumsatzsteuer-Befreiungsverordnung, lit. Ordinance on Relief from Importation Sales Tax

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The End

Thank you for your attention!