

Performance studies on the new generation of iseg HV power supplies

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\bar{P} ANDA Collaboration Meeting 17/1
7th March 2017

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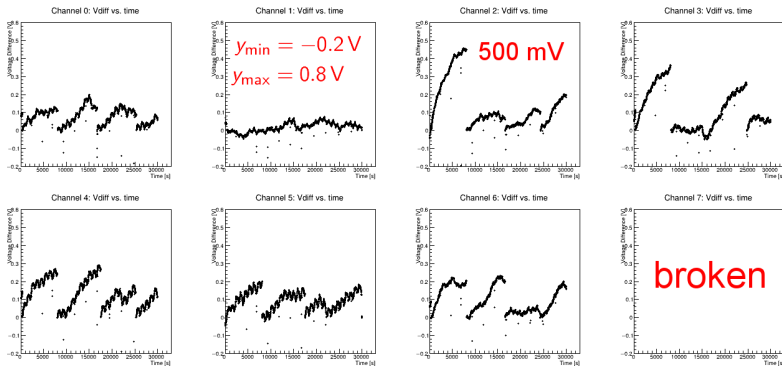
The Problem

- 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
- ⇒ Send old modules to iseg for repair and recalibration
- ⇒ Get some new modules with new hardware from iseg

Background Information and Definitions

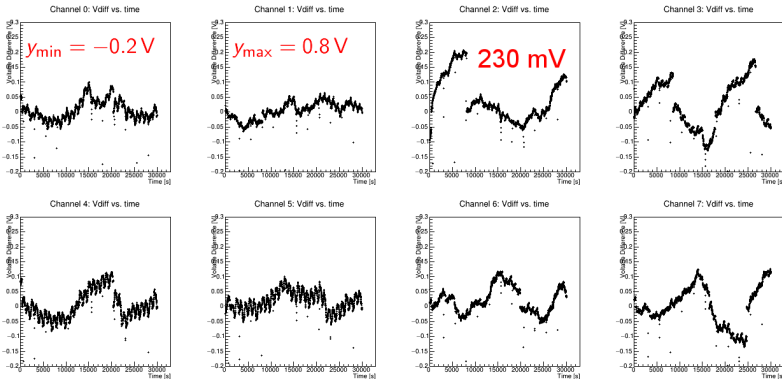
- Old modules were produced in 2008
- iseg redesigned hardware in the meantime
- Distinguishable by serial number:
6 digits \Rightarrow old, 7 digits \Rightarrow new
- Measurand for many plots in this talk: $V_{\text{diff}} = V_{\text{mom}} - V_{\text{set}}$
- x axes in all plots: Time since start of measurement in seconds
- Two usage scenarios for iseg HV modules at Bochum:
 - APD screening: Increase voltage from 0V 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

Module 720060 before repair



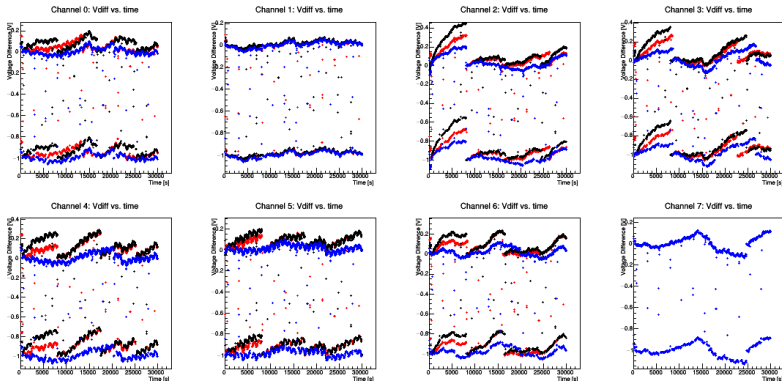
- Old 1 kV high-precision module, 8 channels
- Simulated APD screening
- Reproduction of this test yielded similar results

Module 720060 after Repair



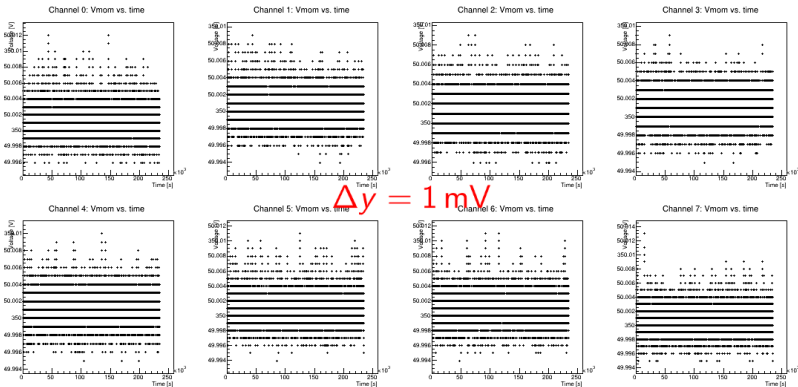
- Module sent to iseg for repair and recalibration (340 €)
- Repeated measurement after return

Module 720060 Comparison before/after



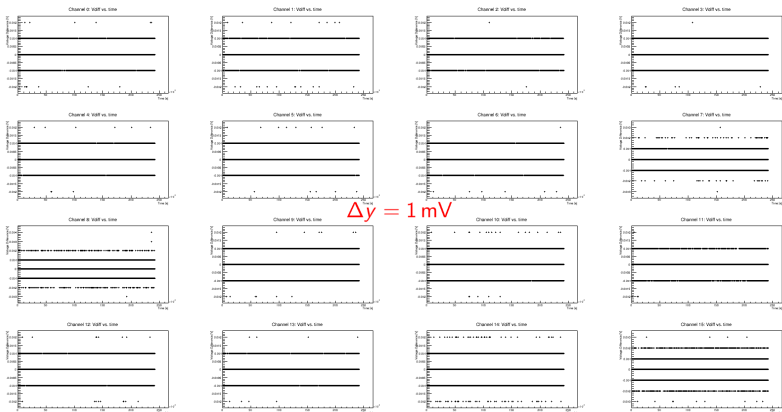
- Black and red: Measurements before repair
- Blue: Measurement after repair

Module 720060 Detector Test



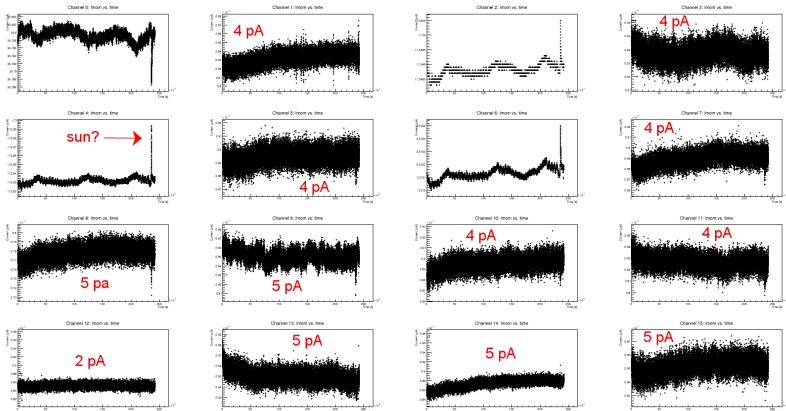
- Simulated detector operation at $V_{\text{set}} = 350 \text{ V}$
- Measured after repair and recalibration
- Fluctuations up to 20 mV

Module 7200017 Voltage Stability



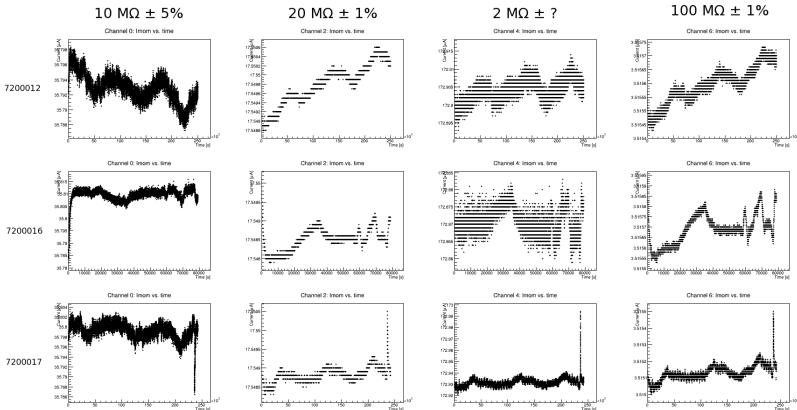
- Same simulation with new module ($V_{\text{set}} = 350 \text{ V}$)
- 241 959 samples (67.2 h) in total, deviations of 2 mV in 7295, 3 mV in 91 and 4 mV in 5 samples

Module 7200017 Current Stability



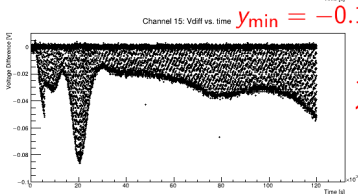
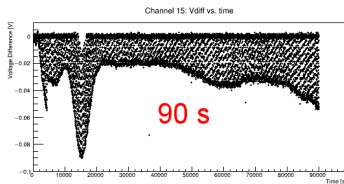
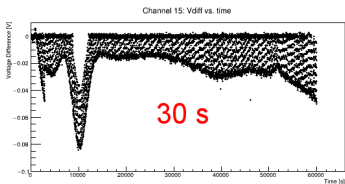
- Ohmic resistors on channels 0, 2, 4, and 6
- Open SHV connector on all other channels

Variations under Ohmic Load

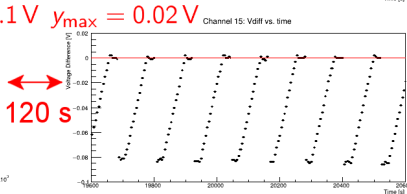


- Fluctuations seem to be caused by resistors (temperature?) and not by HV modules

Using new Modules for APD Screening



$$y_{\min} = -0.1 \text{ V} \quad y_{\max} = 0.02 \text{ V}$$



- Time between voltage steps matters
- Module always reaches V_{set} within 1 mV to 2 mV, but may take up to 120 s

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 $\overline{\text{PANDA}}$

Some Hints for iseg HV Users (1/2)

- New modules generate much more heat than old ones ⇒ provide proper ventilation
 - After power on, regulation logic needs some time for self-calibration until it is stable
- ⇒ Switch on at low V_{set} and wait until isADJ bit in module status register is set
- Default CAN bus bit rate has changed. Old modules shipped with 125 kbps, new modules are pre-programmed to 250 kbps
 - Changing bitrate is possible, but manual is a bit diffuse here and has typos
- ⇒ You can ask iseg as well as me for instructions

Some Hints for iseg HV Users (2/2)

- Old crate controllers (ECH238) can also be re-programmed to baud rate of 250 kbps
 - Programming sequence not in any manual
- ⇒ You can ask iseg as well as me for instructions
- Either change bitrate or remove crate controller from CAN bus
 - Our tests found some bugs and side effects in the firmware for both old and new modules
 - Before new modules were shipped to us in January, iseg made major changes to the firmware
 - Update tools available for Linux and Windows
- ⇒ I recommend to update your modules

The End

Thank you for your attention!