PXD PS Fast Shutdown

Philipp Leitl
phleitl@mpp.mpg.de

Max Planck Institute for Physics

2019-11-13

Max-Planck-Institut für Physik
(Werner-Heisenberg-Institut)

Motivation

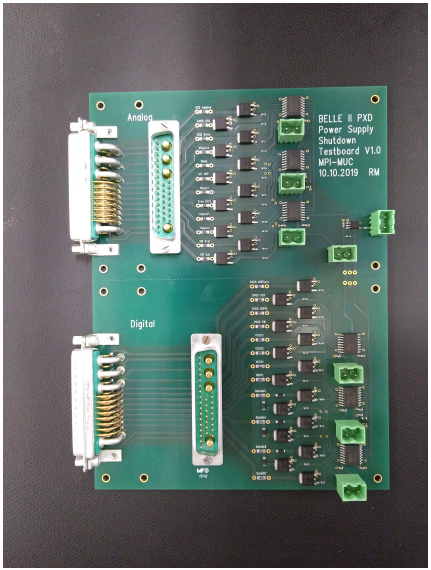
- During the operation of the PXD in the early Phase3 of the BelleII experiment there were several incidents were the detector was exposed to high radiation bursts.
- The exact failure mechnism is not known but multiple matrix rows on all modules were affected and the efficiency was decreased.
- An irradiation campaign to test the module behavior under radiation burst will be carried out in November.
- One possible assumption are latch up effects in the Switcher ASICs. To possibly avoid those in future a faster shutdown of the supply voltages is required.

Speed up of Power Shutdown

Speed up possible at multiple points:

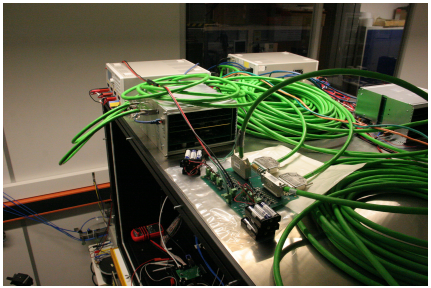
- Get the shutdown signal directly from the diamond abort system:
  Michael Ritzert is working on the interface on PXD side and on getting the signal line from the diamond system. This can lead to an 10 - 12 ms earlier shutdown. At the moment they are refusing an additional connection due to grounding issues until the next shutdown.
- Remove artificial delays between the different domains in the PS itself:
  So far the PS was shutdown in three steps with an internal delay of 200 µs for the last domain. For this change the corresponding PCB has to be removed from the PS and reworked. Six ICs have to be desoldered and the input and output pads have to be shortened.
- Add additional circuit to actively pull down the voltages:
  So far the outputs are only disabled (high-Z) and the applied voltages take their time to decay to the corresponding ground level. An active pull down circuit to quickly drain charges can speed up this process.

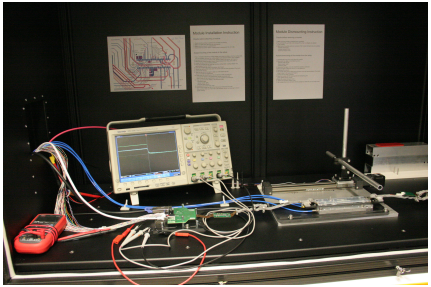
Power Supply Shutdown Testboard



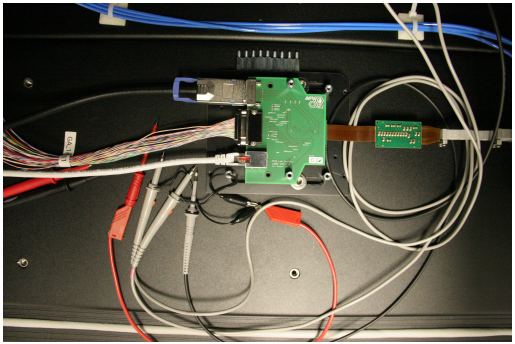
- testboard design by Ronald Maier
- integration into the PS cables close to the PS outputs
- When triggered the transistors open the connections between force lines and corresponding ground.
- inputs:
  - failsafe shutdown signal (has to be high for operation)
  - 5 V for IC supply
  - six times 4.5 V battery supplies for transistors at different domains
- remark: gate-on1, 2 and 3 change their polarity depending on the operation state. Therefore, two opposite transistors and two decoupling diodes are required.

Measurements - Setup

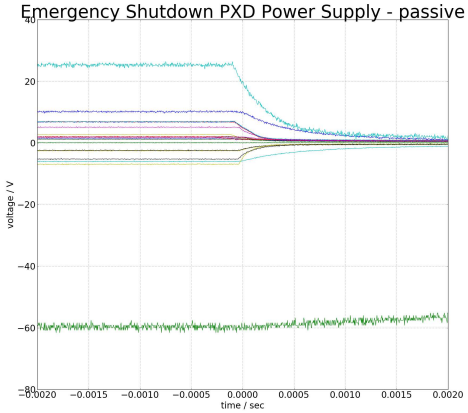


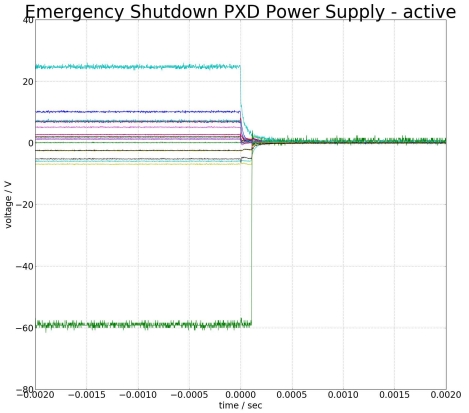


- Module: W09_OB1 (broken ladder L2_043)
- LMU-PS: 54.1 and 54 (delays removed)
- signals measured at the accessible pads or vias of the LabPatchPanel



Measurements - Results





The largest effect is seen on the HV line. But also all other lines are discharged faster. The gain depends on the line (up to 1 ms).