Efficiency Study using DC-DC Converter

Efficiency measured at PSI October 2019

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testbeam contributors:
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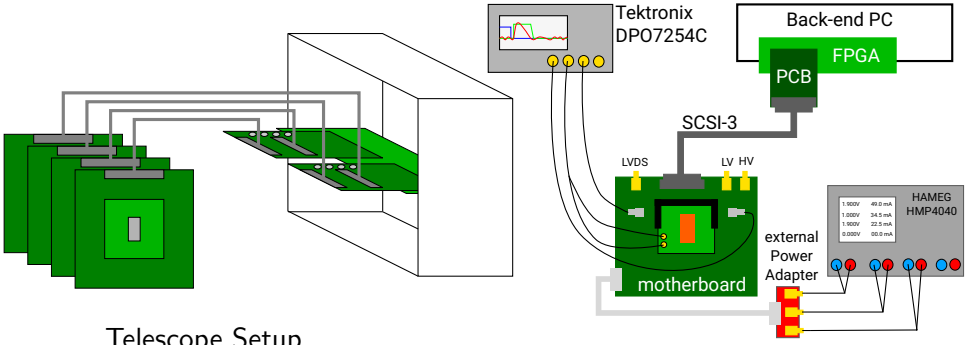
First DC-DC Powering Tests at a Testbeam

- 1 kΩ cm sensor from Batch 1 (pre-production) tested as indicator
- powering of supply voltages only from one sensor side! (only one-sided bonded)
- Sensor Configuration tested by Thomas and David at PSI beforehand

→ only DAC values for link stability optimized!

- testbeam data analyzed by Luigi Vigani

The Measurement Setup

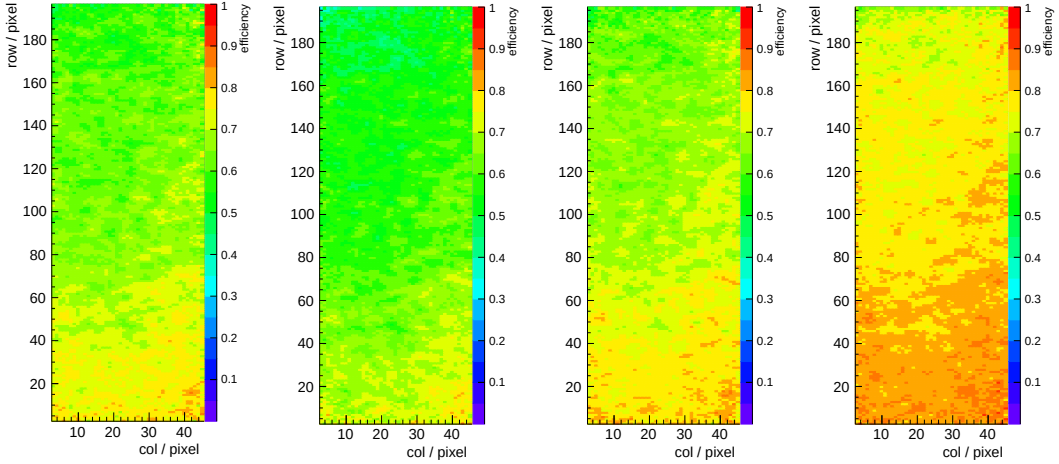


Performed Scans

Board Type	VDDA	VDD	VSSA[1]	Shorted
Normal			981mV	no
External power	Hameg	Hameg	981mV	no
External power	Hameg	Hameg	1050mV	no
External power	Hameg	Hameg	1050mV	no
External power	Hameg	Hameg	1150mV	no
External power	DC-DC	DC-DC	980mV	VDD&VDDA
External power	DC-DC	DC-DC	1050mV	VDD&VDDA
External power	DC-DC	DC-DC	1150mV	VDD&VDDA
External power	Hameg	DC-DC	980mV	no
External power	DC-DC	Hameg	1150mV	no

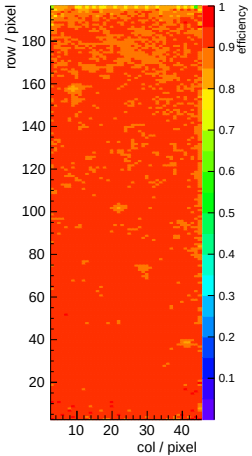
[1] supplied by Hameg and measured on insert

ROI Efficiency Maps for DC-DC @−40 V & 60 mV threshold

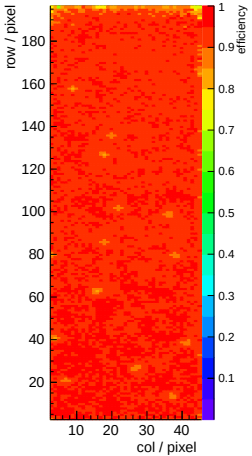


Can be recovered by ...

Efficiency Map for VDDA&VDD shorted (DC-DC) @ higher VSSA

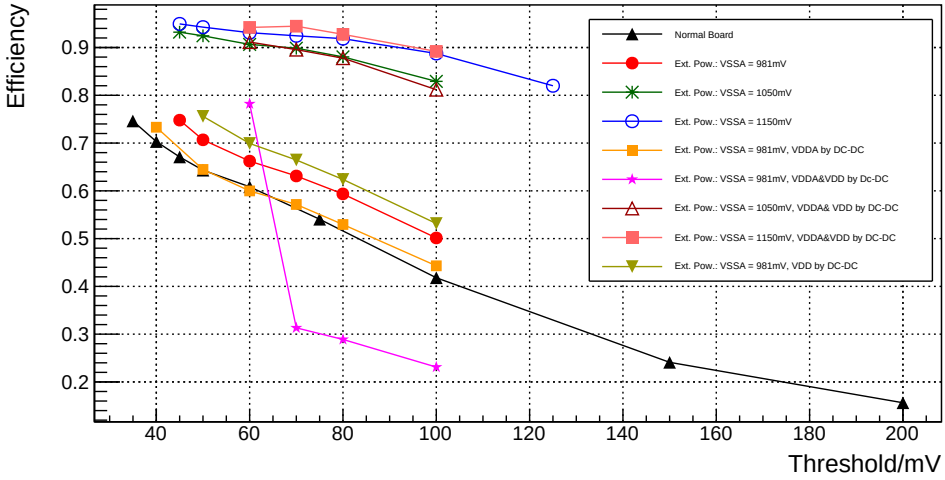


VSSA = 1050 mV



VSSA = 1150 mV

Threshold Scans @−40 volt



Summary & Outlook

- first look into the effects of the DC-DC powering are promising

→ shorted VDDA and VDD do not decrease the efficiency

- inefficiency by voltage drop over sensor can be recovered by higher VSSA voltages

→ difference between VDDA & VSSA $\sim 0.7\,\mathrm{V}$

- however test to be redone with $200\,\Omega\,\mathrm{cm}$

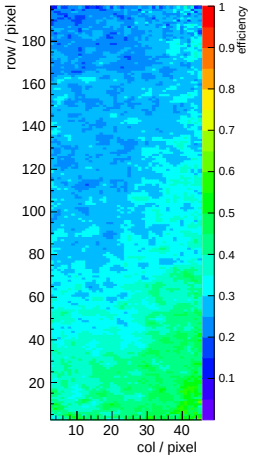
→ 2-side bonding allows modular supplement of power from both sides via jumpers

For upcoming December Testbeam at DESY:

- $200\,\Omega\,\mathrm{cm}$ sensors (bonding in progress) to be tested in lab (observe the AmpOut)
- DC-DC powering for VDD, VDDA & **VSSA**
- 8 b/10 b errors observation at different power settings
- Ripple studies on the different powering configurations

BACKUP

Efficiency Map for VDDA&VDD shorted (DC-DC) @ 70 mV threshold

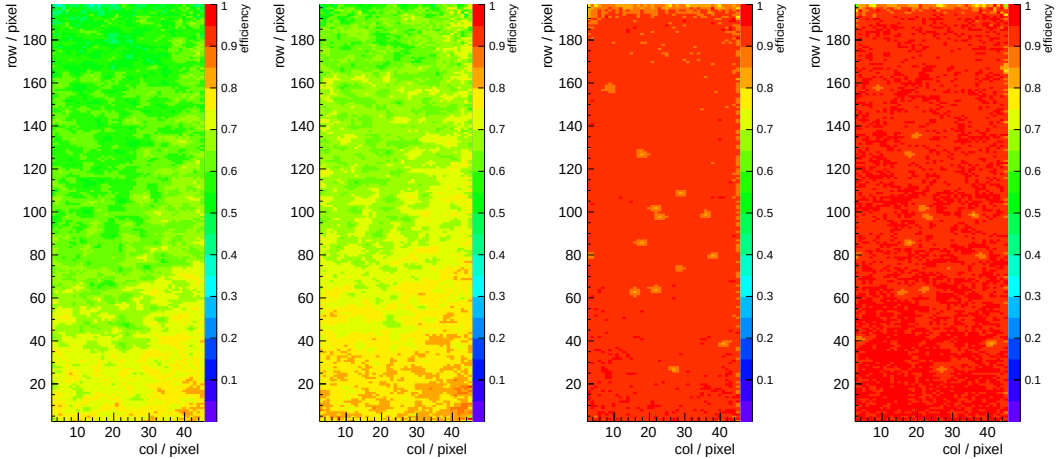


- sensor is unstable and reason is unknown!

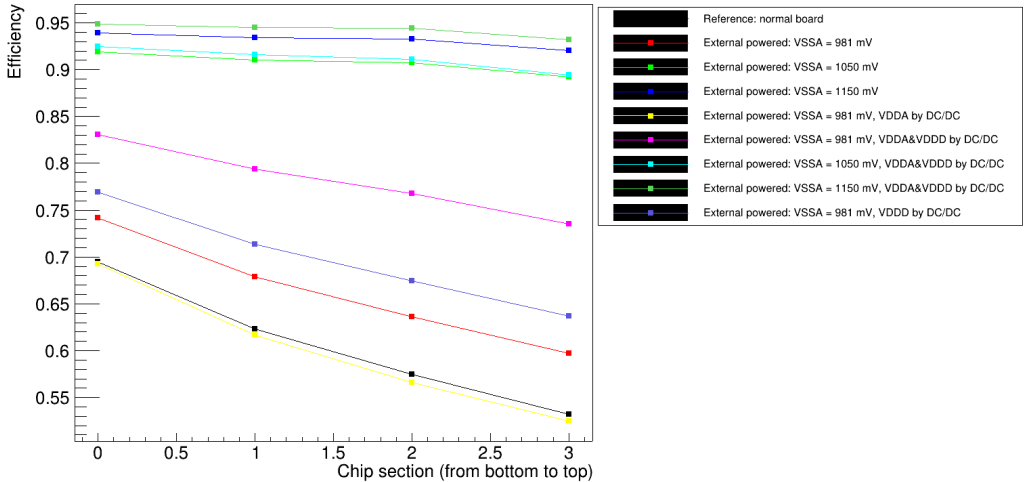
other possible explanation:

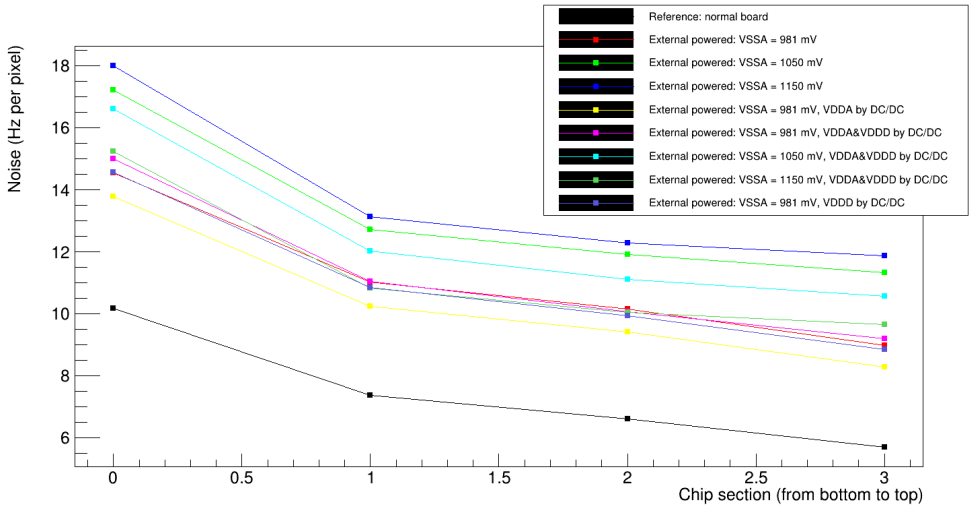
- difference between VSSA and VDDA are too high & unstable which results in higher efficiency loss

ROI Efficiency Maps External Powering @−40 V & 50 mV threshold



Normal Board VSSA = 981 mV VSSA = 1050 mV VSSA = 1150 mV


Efficiency
0.95
0.9
0.85
0.8
0.75
0.7
0.65
0.6
0.55
0
0.5
1
1.5
2
2.5
3
Chip section (from bottom to top)
Reference: normal board
External powered: VSSA = 981 mV
External powered: VSSA = 1050 mV
External powered: VSSA = 1150 mV
External powered: VSSA = 981 mV, VDDA by DC/DC
External powered: VSSA = 981 mV, VDDA&VDDD by DC/DC
External powered: VSSA = 1050 mV, VDDA&VDDD by DC/DC
External powered: VSSA = 1150 mV, VDDA&VDDD by DC/DC
External powered: VSSA = 981 mV, VDDD by DC/DC


Reference: normal board
External powered: VSSA = 981 mV
External powered: VSSA = 1050 mV
External powered: VSSA = 1150 mV
External powered: VSSA = 981 mV, VDDA by DC/DC
External powered: VSSA = 981 mV, VDDA&VDDD by DC/DC
External powered: VSSA = 1050 mV, VDDA&VDDD by DC/DC
External powered: VSSA = 1150 mV, VDDA&VDDD by DC/DC
External powered: VSSA = 981 mV, VDDD by DC/DC
Noise (Hz per pixel)
18
16
14
12
10
8
6
0
0.5
1
1.5
2
2.5
3
Chip section (from bottom to top)