

Irradiations of Hamamatsu SCT Series Detectors

Dave Robinson, Cambridge, SCT Week 29/9-04/10 2002

We typically irradiate ~0.5% of Hamamatsu series detectors delivered to the UK.

These irradiations are performed to ensure consistency of post-irradiation electrical behavior between detectors and in comparison to the qualification detectors.

Post irradiation measurements comprise:

- Leakage Currents (every detector)
- Signal vs Bias, using SCT128A (sample)

Detector preparations, assembly, post-irrad annealing and testing are performed at Cambridge.

All details including test measurements are available publicly on the Cambridge Silicon website:

<http://www.hep.phy.cam.ac.uk/silicon>

Silicon Detector Development in the Cambridge HEP Group - Microsoft Internet Explorer

Address: <http://www.hep.phy.cam.ac.uk/silicon/>

UNIVERSITY OF CAMBRIDGE

Silicon Development in the HEP Group

Detector Irradiations
[Contact the author of this website.](#)

Irradiations of Hamamatsu SCT Production Detectors

All detector irradiations at the CERN PS to approximately $3e14p.cm^{-2}$.
 Unless where otherwise stated, all detector preparations, assembly, annealing and tests are performed at Cambridge.
 To view the test data, please click on the *description of the test*.

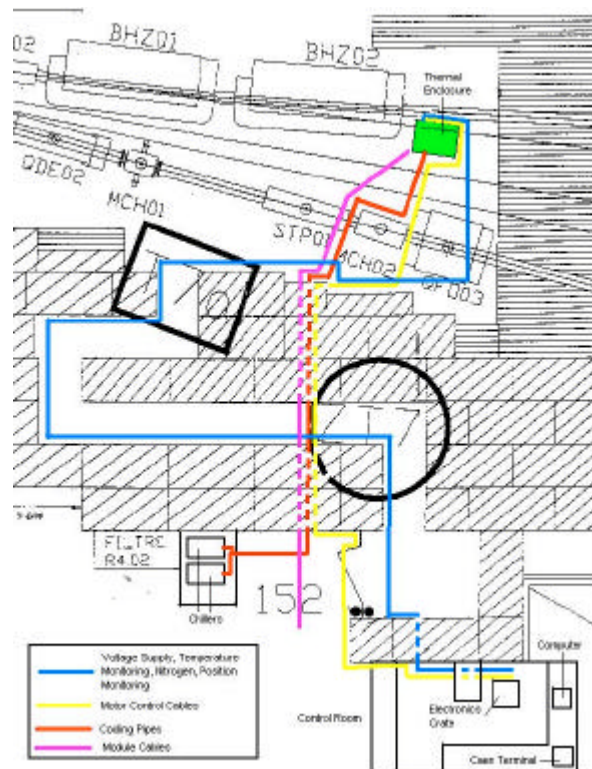
Serial No	Type	Assembled	Irradiation	Return Date	Annealing	Comments
> Detectors irradiated during Apr-01 (Irradiation 1)						
20220900201316	B2 Series	Mar-01	Apr-01	01-Jun-01	04-jun-01 7days@25C	None
20220900201324	B2 Series	Mar-01	Apr-01	01-Jun-01	04-jun-01 7days@25C	None
20220900201338	B2 Series	Mar-01	Apr-01	01-Jun-01	04-jun-01 7days@25C	None
20220900300089	W12 Series	Mar-01	Apr-01	01-Jun-01	04-jun-01 7days@25C	None
20220900300090	W12 Series	Mar-01	Apr-01	01-Jun-01	04-jun-01 7days@25C	None
20220900300091	W12 Series	Mar-01	Apr-01	01-Jun-01	04-jun-01 7days@25C	None
20220900600156	W31 Series	28-Mar-01	Apr-01	01-Jun-01	04-jun-01 7days@25C	None
20220900600157	W31 Series	28-Mar-01	Apr-01	01-Jun-01	04-jun-01 7days@25C	None
20220900700121	W32 Series	28-Mar-01	Apr-01	01-Jun-01	04-jun-01 7days@25C	None
20220900700122	W32 Series	28-Mar-01	Apr-01	01-Jun-01	04-jun-01 7days@25C	None
20220900200729	B2 Series -100	Nobu-Japan	Apr-01	01-Jun-01	04-Jun-01 7days@25C	None
20220900200737	B2 Series - 100	Nobu-Japan	Apr-01	01-Jun-01	04-Jun-01 7days@25C	None
20220900200751	B2 Series - 100	Nobu-Japan	Apr-01	01-Jun-01	04-Jun-01 7days@25C	None
20220900200834	B2 Series - 100	Nobu-Japan	Apr-01	01-Jun-01	04-Jun-01 7days@25C	None
20220900200921	B2 Series - 100	Nobu-Japan	Apr-01	01-Jun-01	04-Jun-01 7days@25C	None
20220900200969	B2 Series - 100	Nobu-Japan	Apr-01	01-Jun-01	04-Jun-01 7days@25C	None
20220900201331	B2 Series	Nobu-Japan	Apr-01	01-Jun-01	04-Jun-01 7days@25C	None
20220900201389	B2 Series	Nobu-Japan	Apr-01	01-Jun-01	04-Jun-01 7days@25C	None
20220900201416	B2 Series	Nobu-Japan	Apr-01	01-Jun-01	04-Jun-01 7days@25C	None
20220900201467	B2 Series	Nobu-Japan	Apr-01	01-Jun-01	04-Jun-01 7days@25C	None
> Test Data for detectors irradiated during Apr-01:						
IV Summary Cambridge Detectors	Comments: None					
IV Summary Nobu Detectors	Comments: Strips grounded					
IV Summary Nobu Detectors	Comments: Strips floating					
SCT128A Data W31-157	Comments: None					
SCT128A Data W32-121	Comments: None					
SCT128A Data W32-122	Comments: None					

Irradiation Conditions

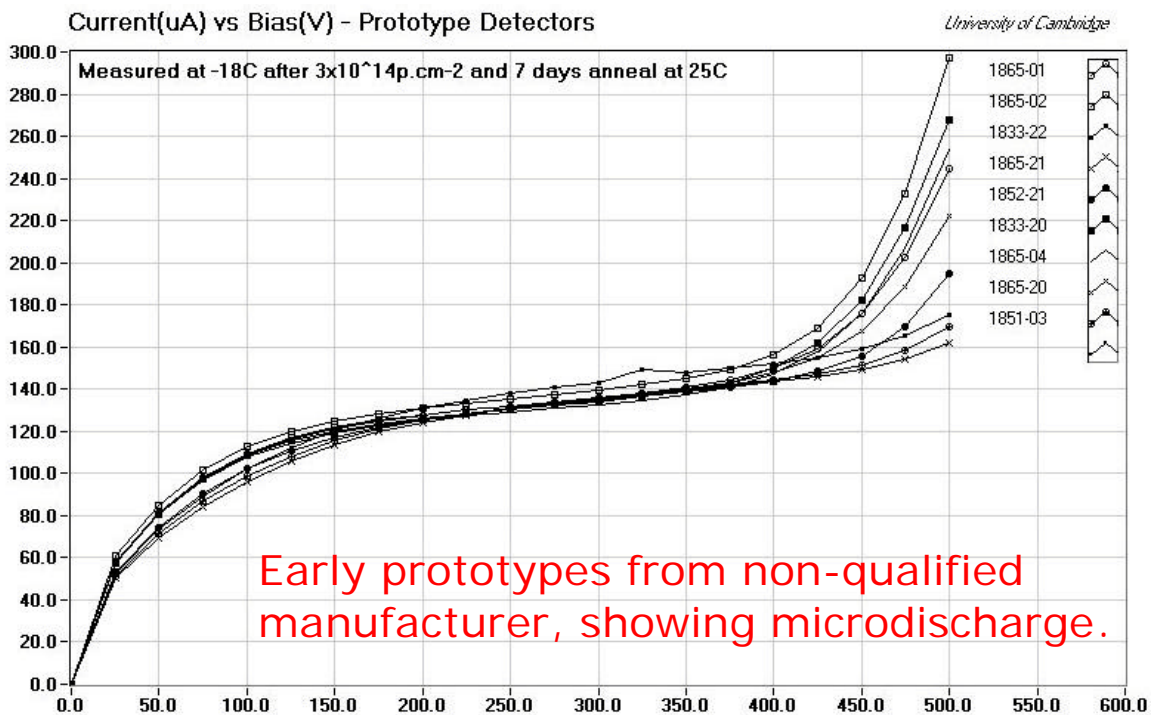
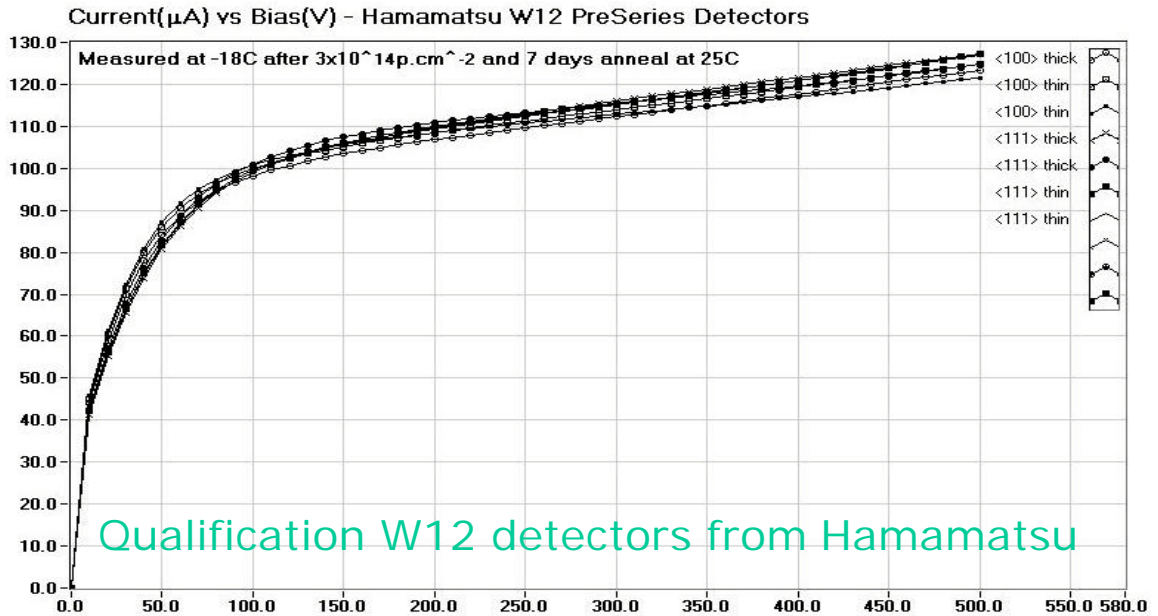


The detectors are irradiated with 24 GeV/c protons to $3 \times 10^{14} \text{p.cm}^{-2}$ at the T7 irradiation facility under the following conditions:

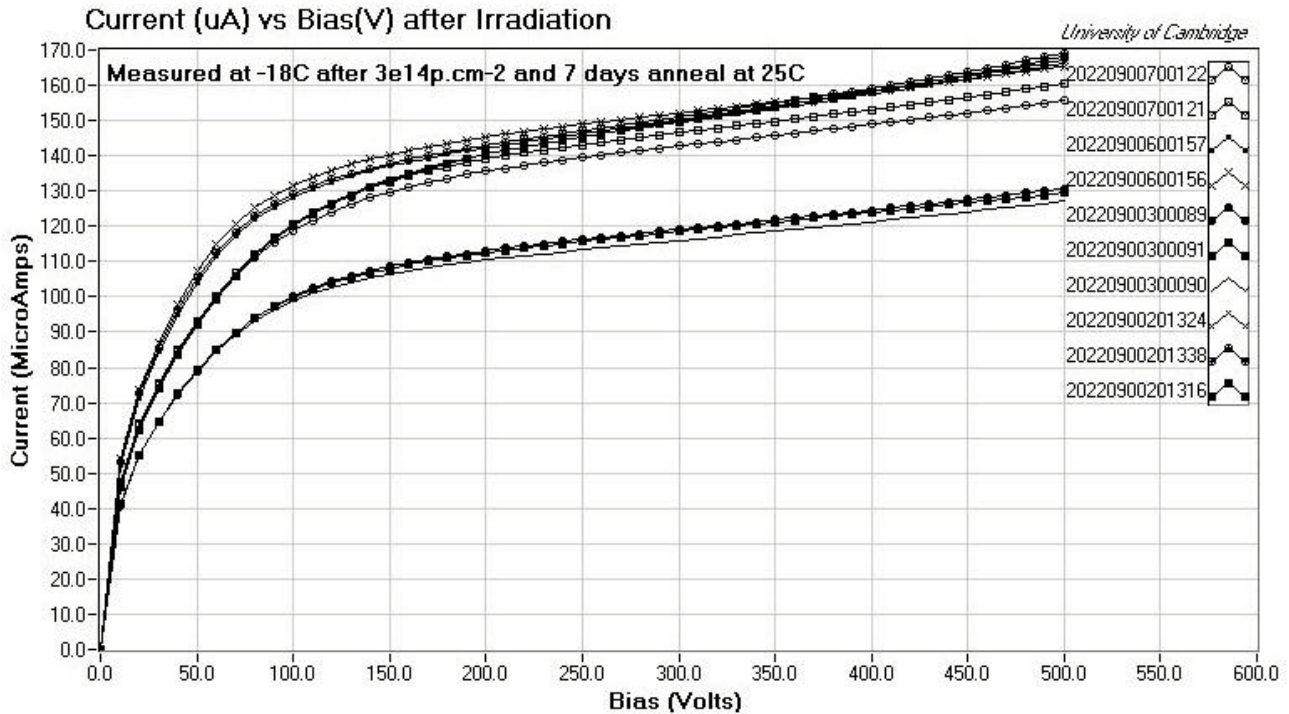
- Temperature -8°C
- Strips grounded
- Post irradiation annealing at 25°C for 7 days



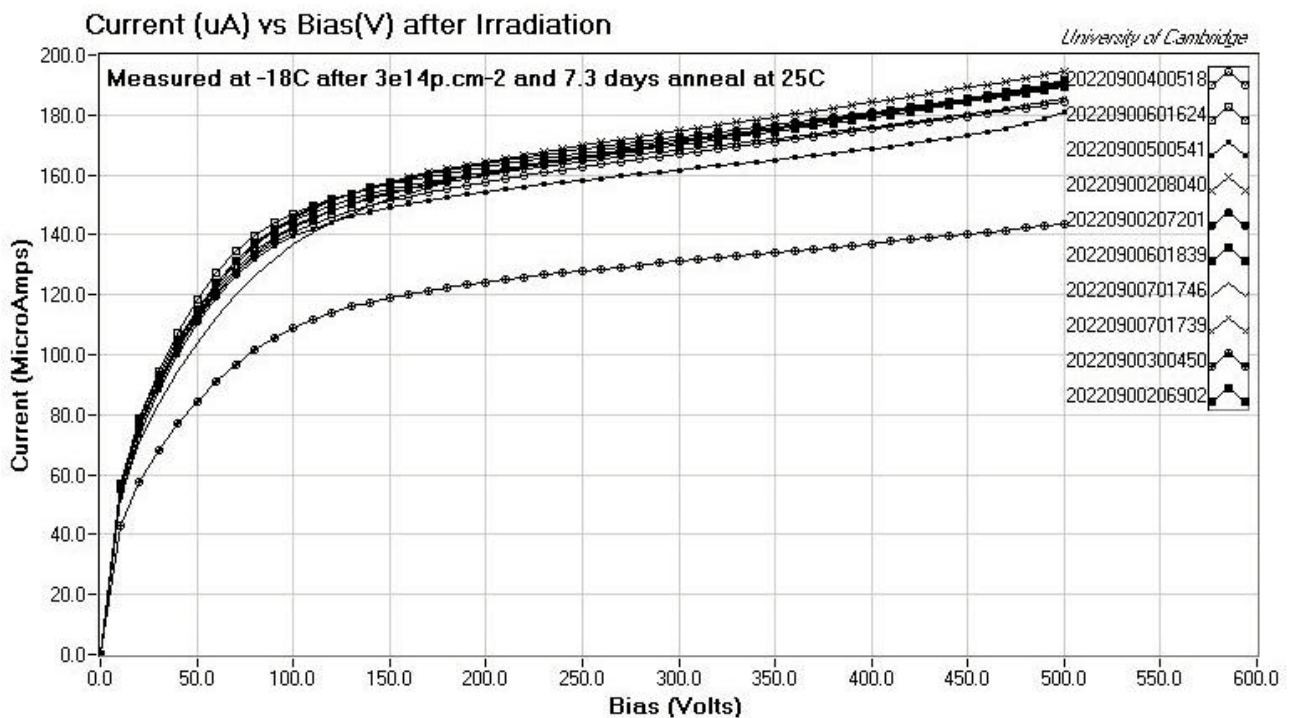
Post-Irradiation leakage current measurements are our main diagnosis tool



April 2001 Irradiation, various shapes.



May 2002 Irradiation, various shapes.



Analogue Readout using SCT128A

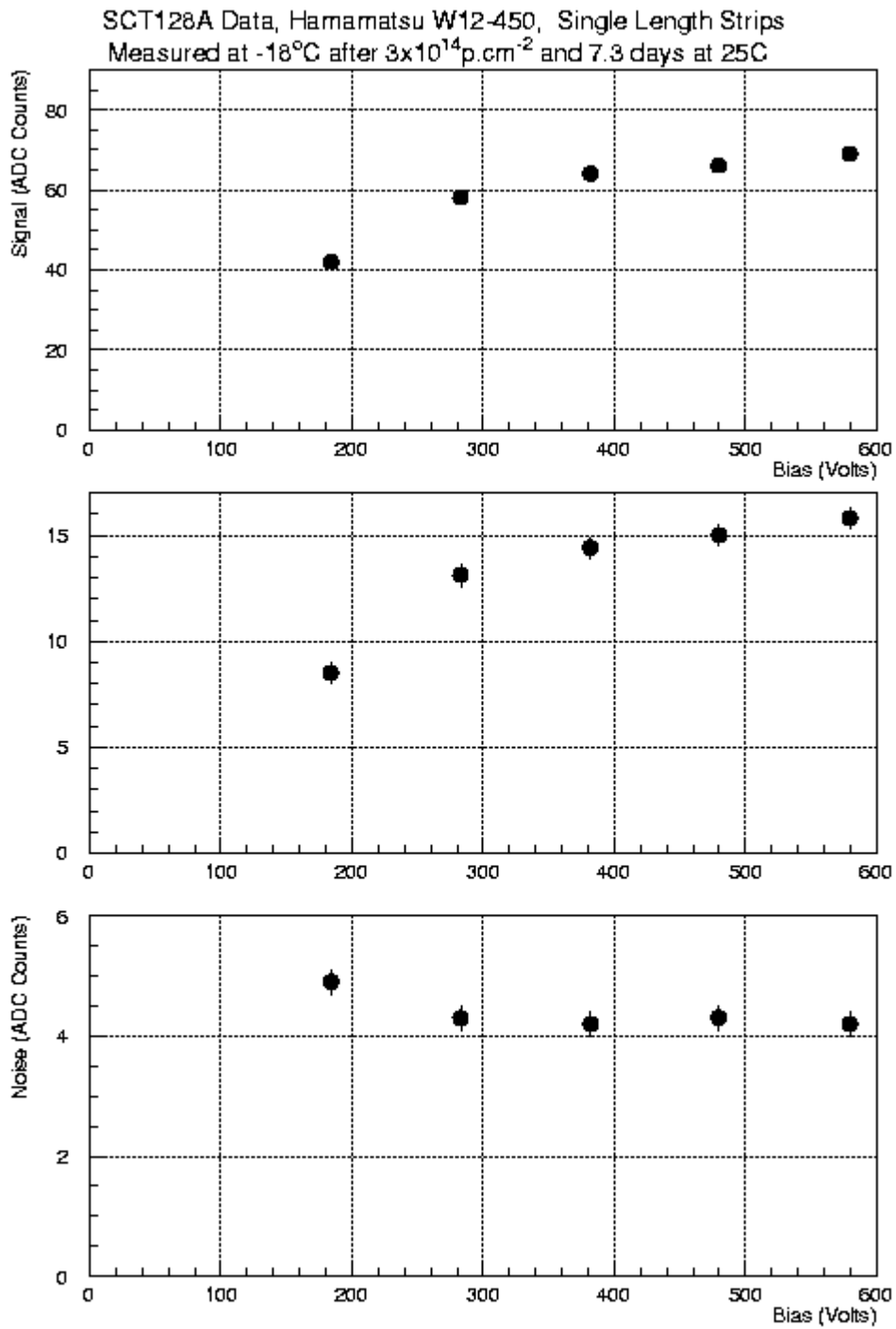
128 strips are bonded to a SCT128A chip via a series of re-useable pitch adaptors.

Measurements of signal vs bias are made with a Ru^{106} γ -source positioned $\sim 1\text{cm}$ above the detector surface, and a scintillator $\sim 1\text{cm}$ below the detector.

Data acquisition and analysis all performed using LabView.

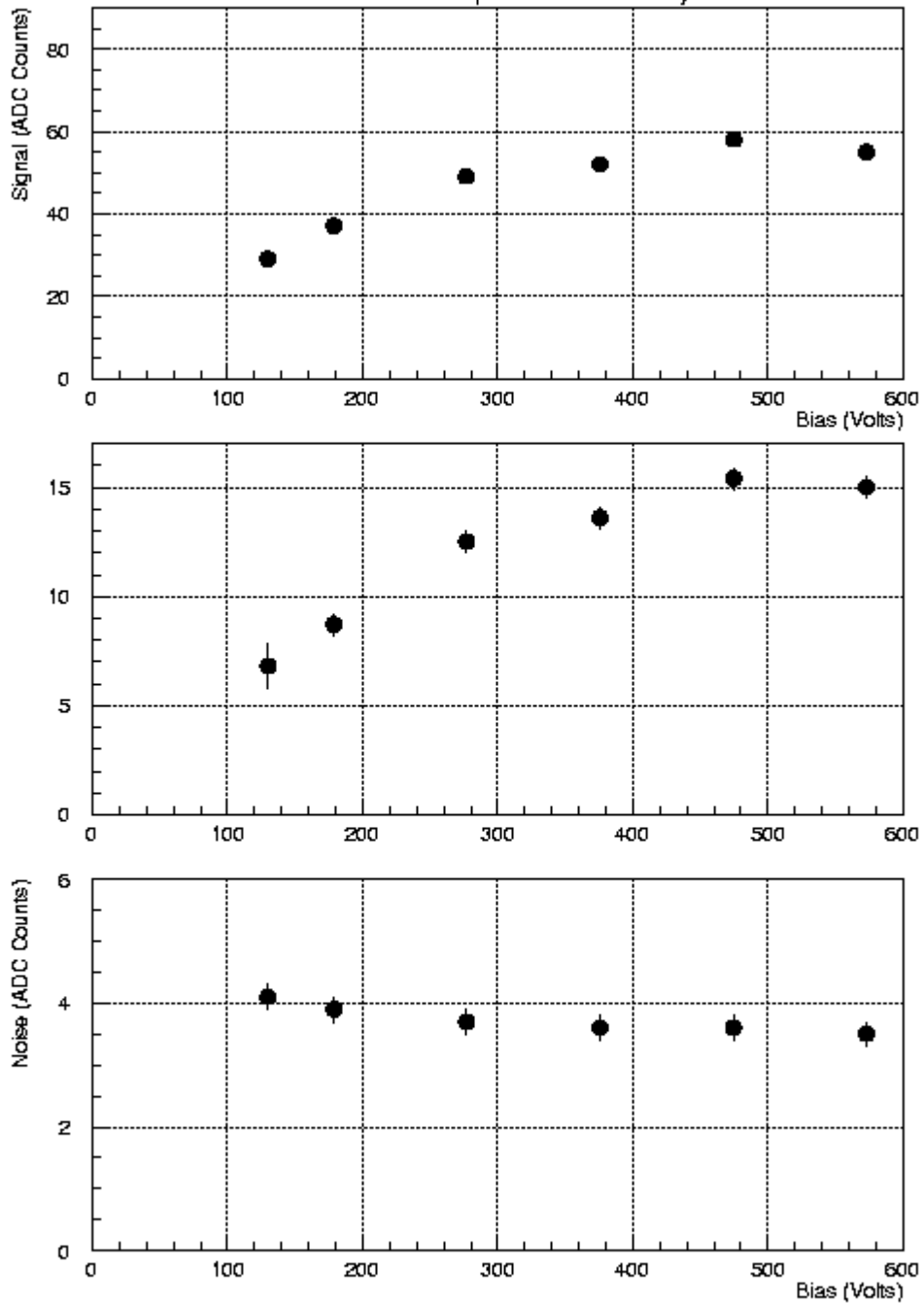


SCT128A Data - W12 20220900300450



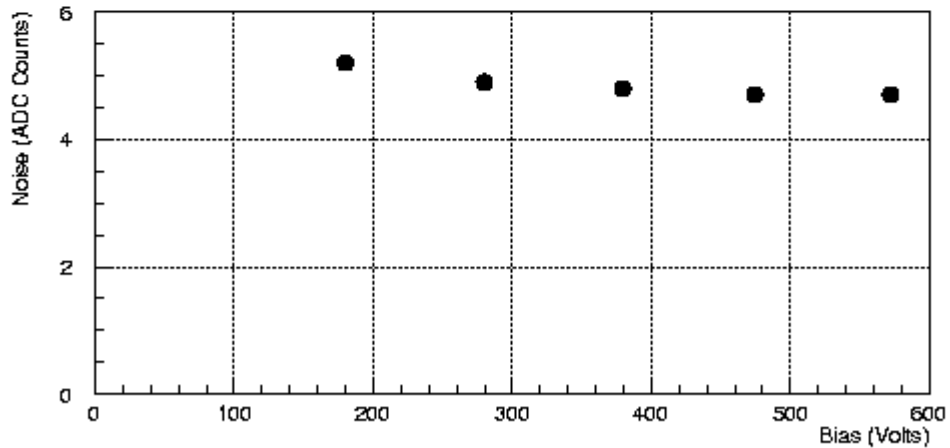
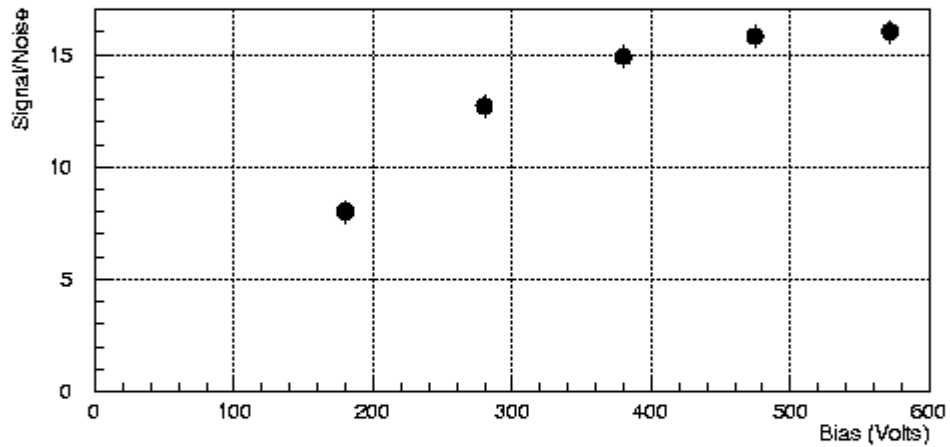
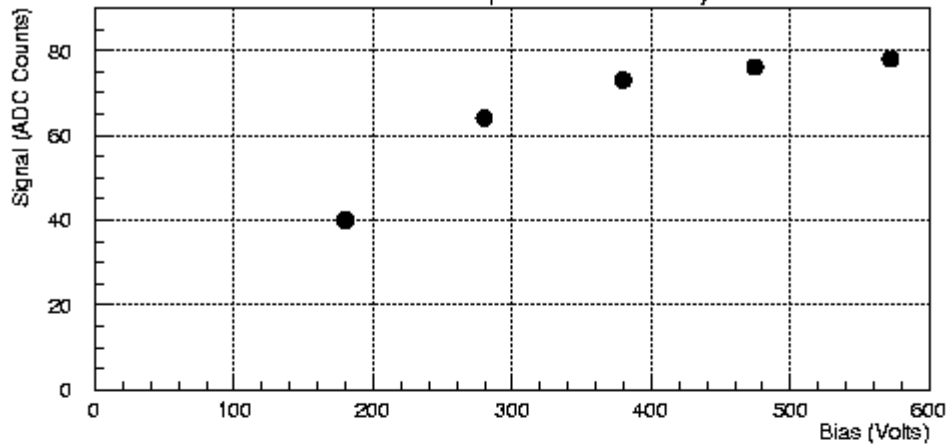
SCT128A Data - B2 20220900207201

SCT128A Data, Hamamatsu B2-7201, 6cm Strips
Measured at -18°C after $3 \times 10^{14} \text{p.cm}^{-2}$ and 7.3 days at 25°C

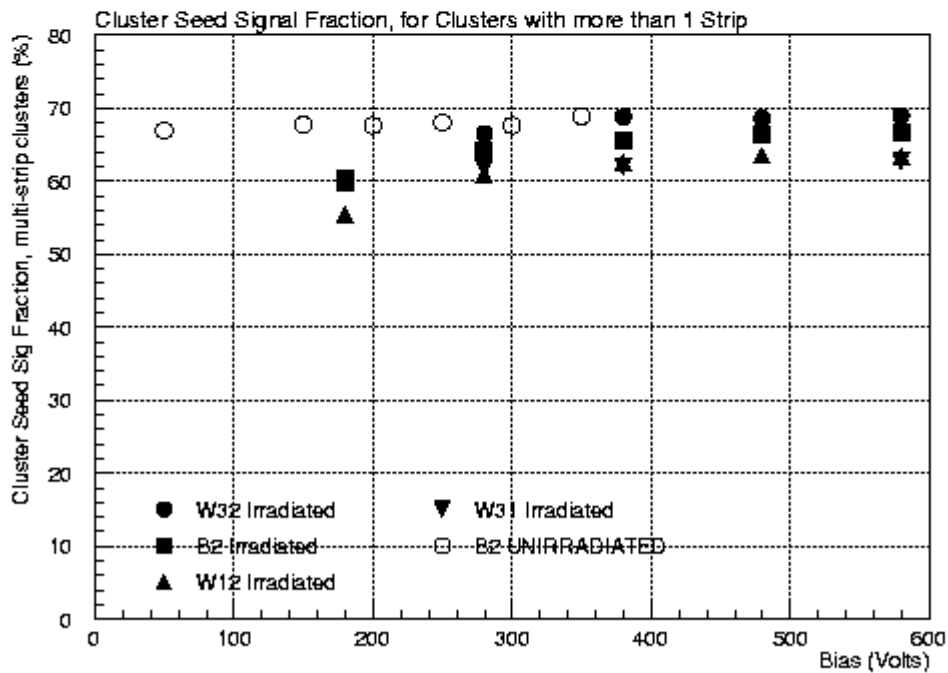
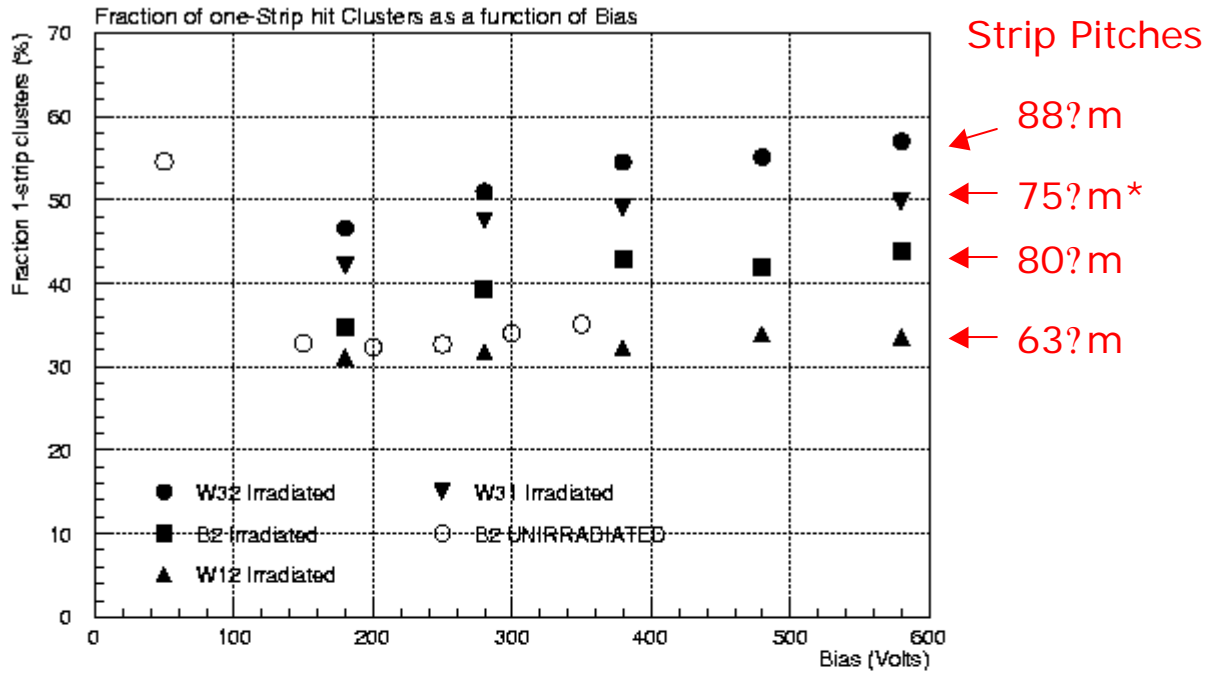


SCT128A Data - W32 20220900701739

SCT128A Data, Hamamatsu W32-1739, Single Length Strips
Measured at -18°C after $3 \times 10^{14} \text{ p.cm}^{-2}$ and 7.3 days at 25°C



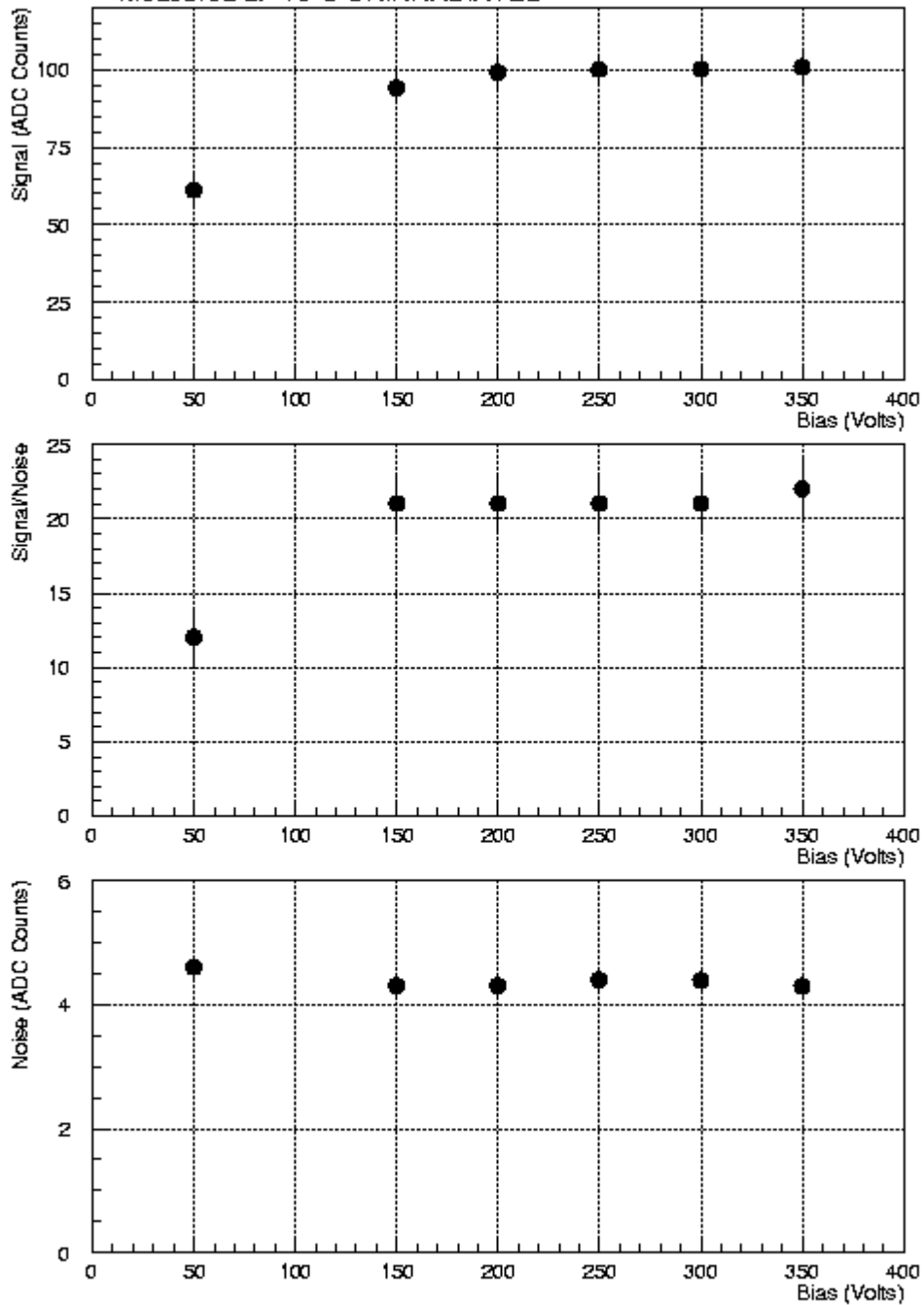
"Binary" Analysis of SCT128A Data



(*The W31 data was taken with the wrong time bucket)

SCT128A Data - Unirradiated Barrel

SCT128A Data, Hamamatsu B2-8576, 6cm Strips
Measured at -18°C UNIRRADIATED



Summary

- Throughout production of the SCT detectors, we have been regularly irradiating small representative samples of detectors of all shapes.
- The motivation has been to identify undesirable changes in post-irradiation behavior (such as microdischarge or any change in the signal vs bias) compared to qualification detectors.
- We have so far irradiation ~30 barrels and 4-6 of each wedge shape.
- So far all post-irradiation behavior has been consistent with qualified detectors and with other irradiated detectors
- No evidence so far of any differences between wedge and barrel detectors in their post-irradiation behavior