

IV Measurements on RD50 Sensors

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5-1-08

Inventory

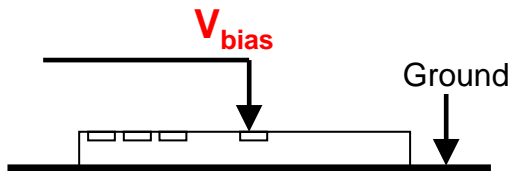
- 23 Boxes
 - Each contains a long sensor (L) and two short sensors (S1 and S2)
 - A “completed” box means we have IV measurements for all three sensors
- Boxes are grouped by:
 - Type (P-type or N-type)
 - Method for crystal growth (MCz or FZ)

Inventory- method and type

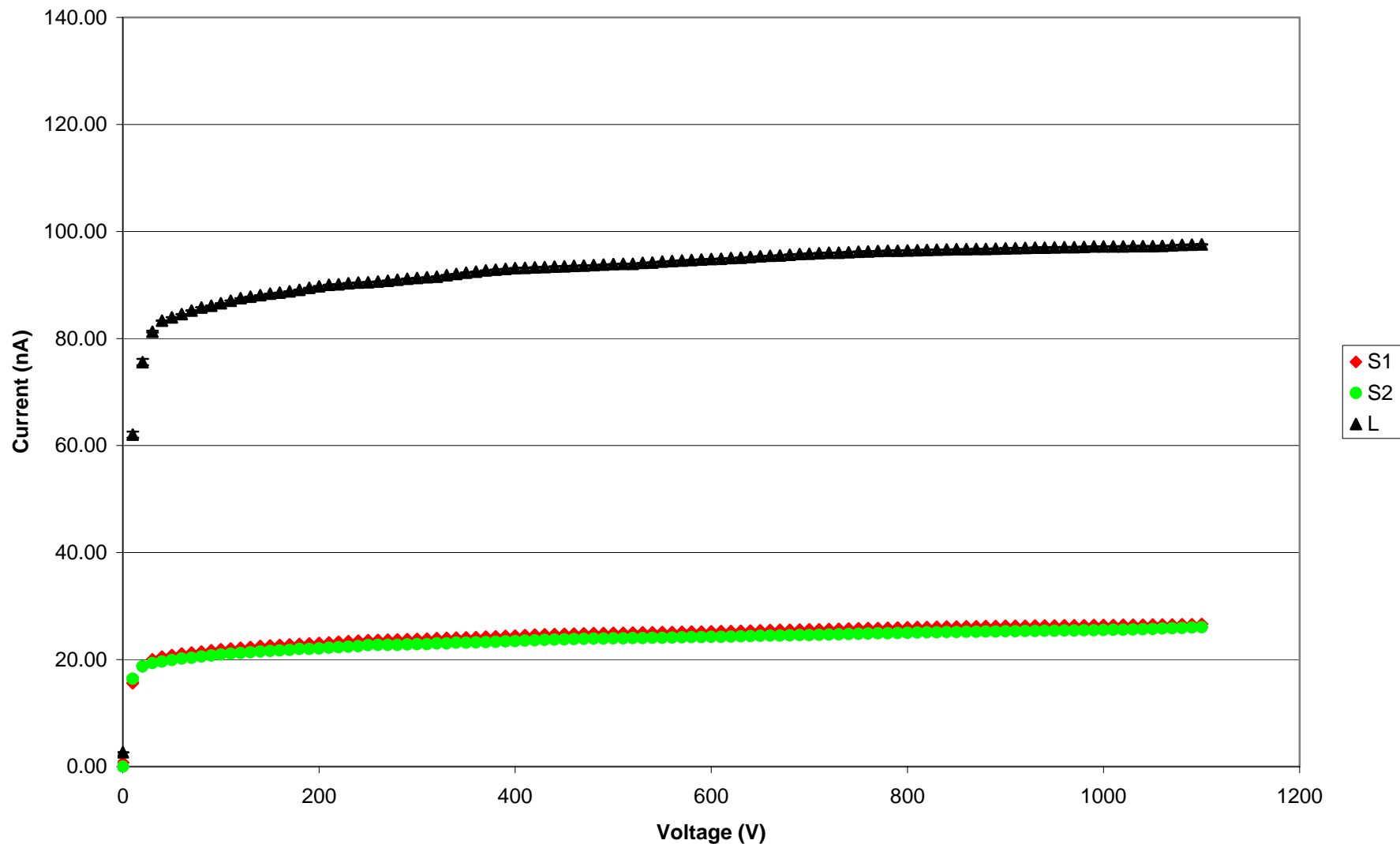
23 Boxes → 17 completed

- MCz (11 total)
 - 10 completed
 - 1 not completed
- FZ (11 total)
 - 7 completed
 - 4 not completed
- FZN (1 total)
 - 0 completed
 - 1 not completed
- P-type (11 total)
 - 9 completed
 - 2 not completed
- N-type (12 total)
 - 8 completed
 - 4 not completed

Sensor:
2535-10

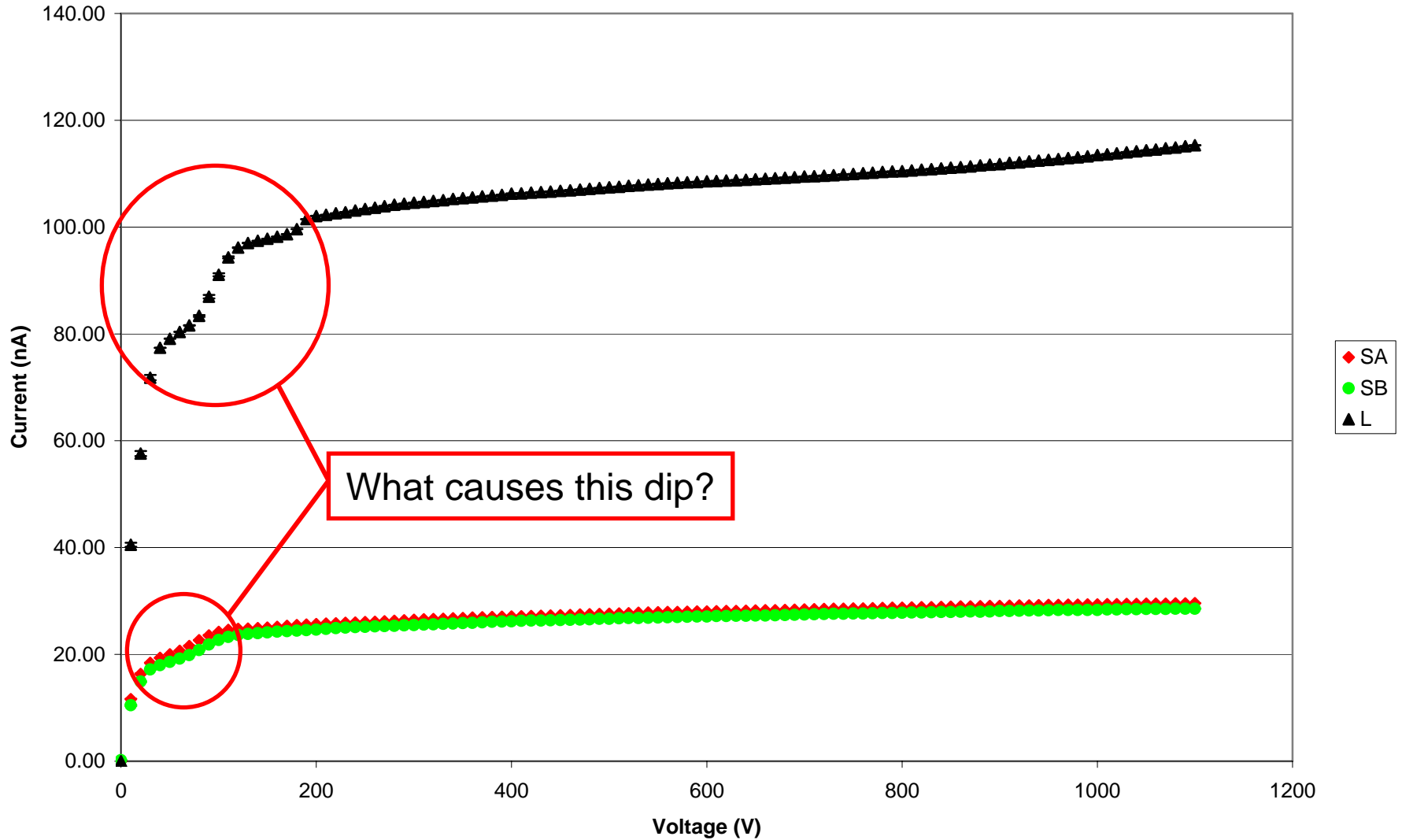
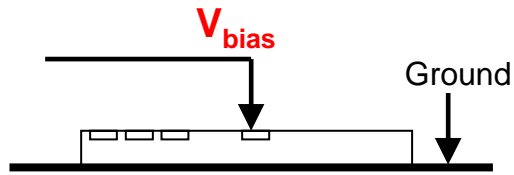


Type / Silicon Method:
N-type / FZ

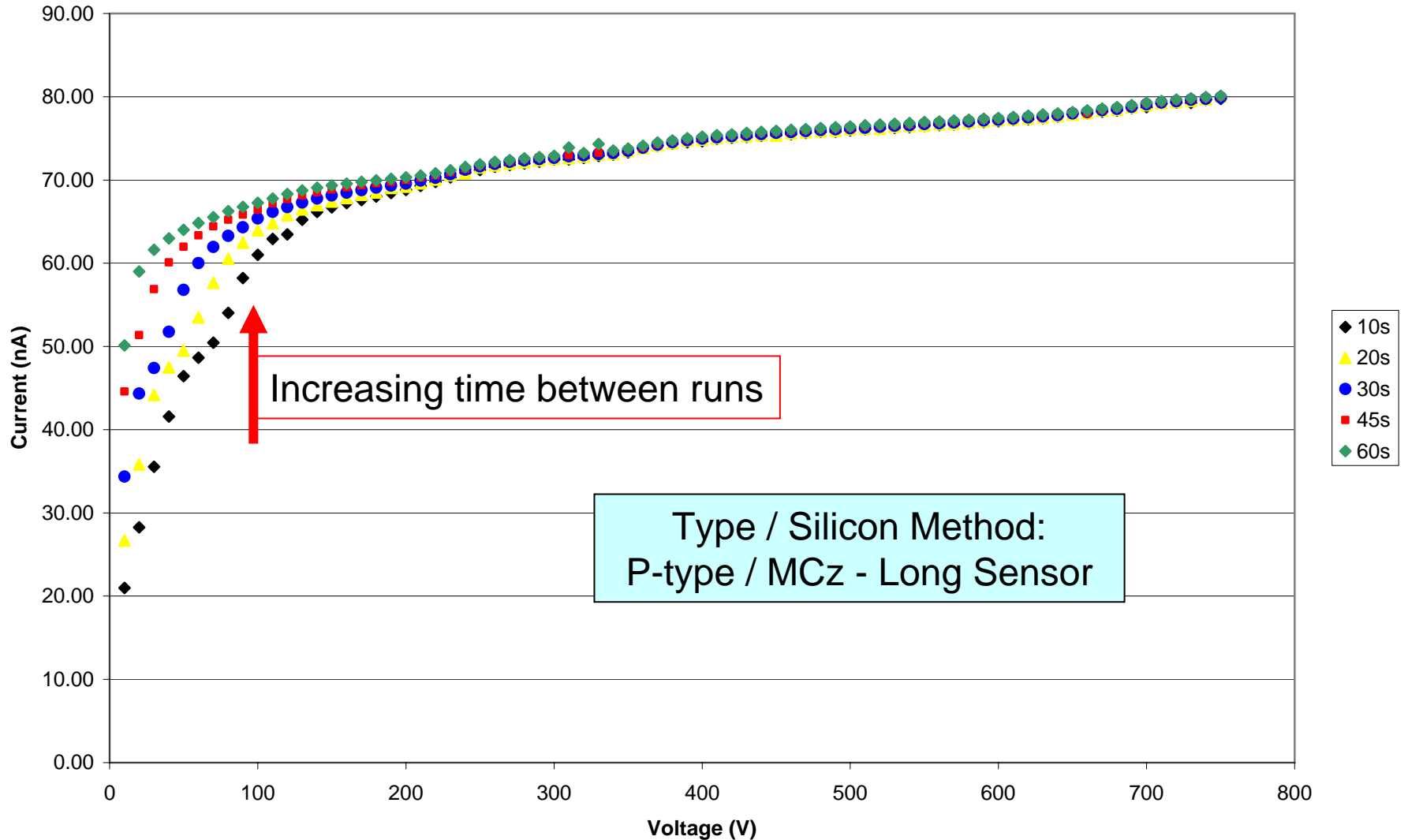


Sensor:
2535-8

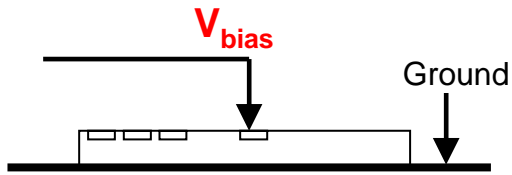
Type / Silicon Method:
N-type / FZ



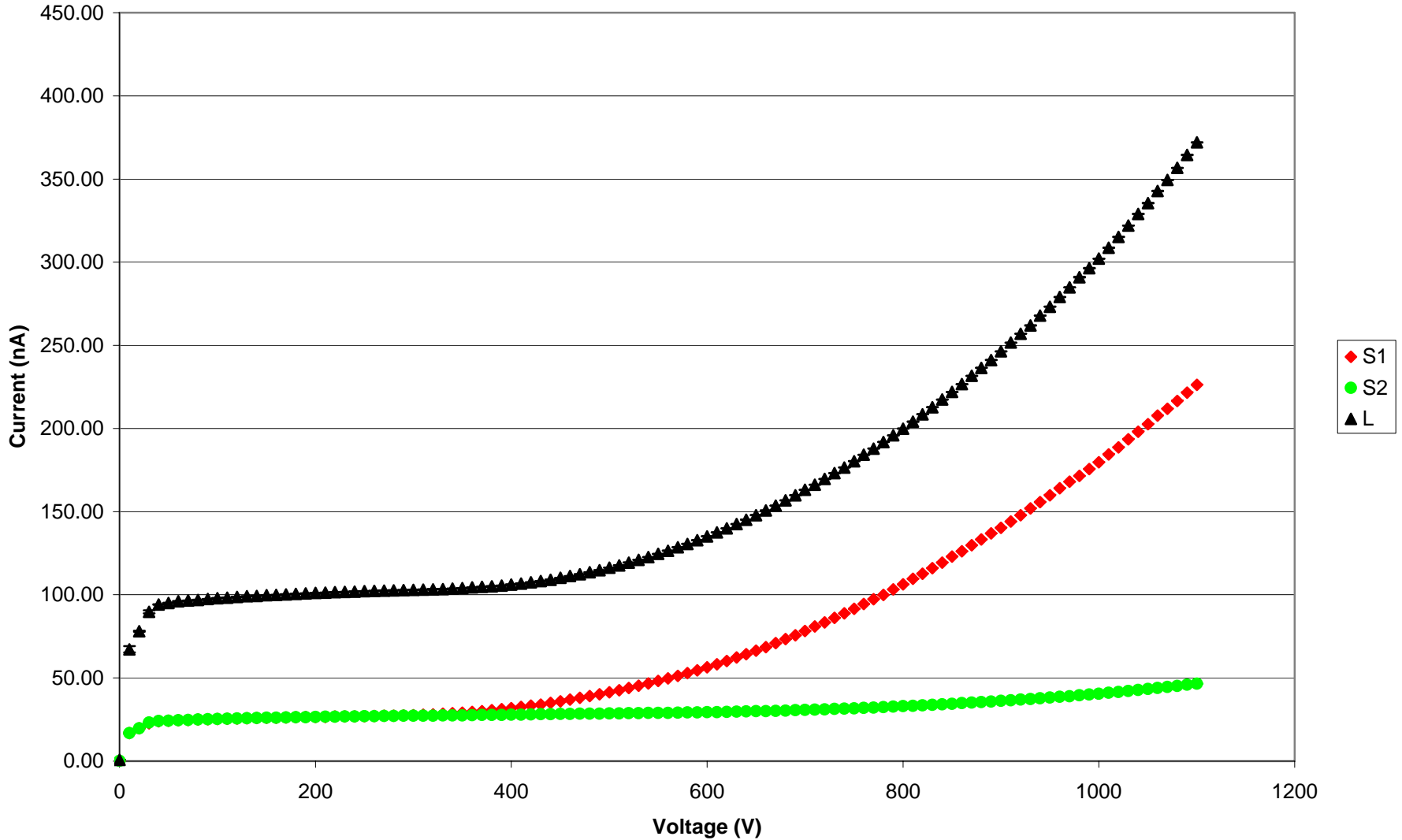
Time Between Runs



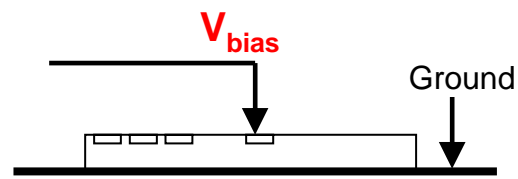
Sensor:
2552-11



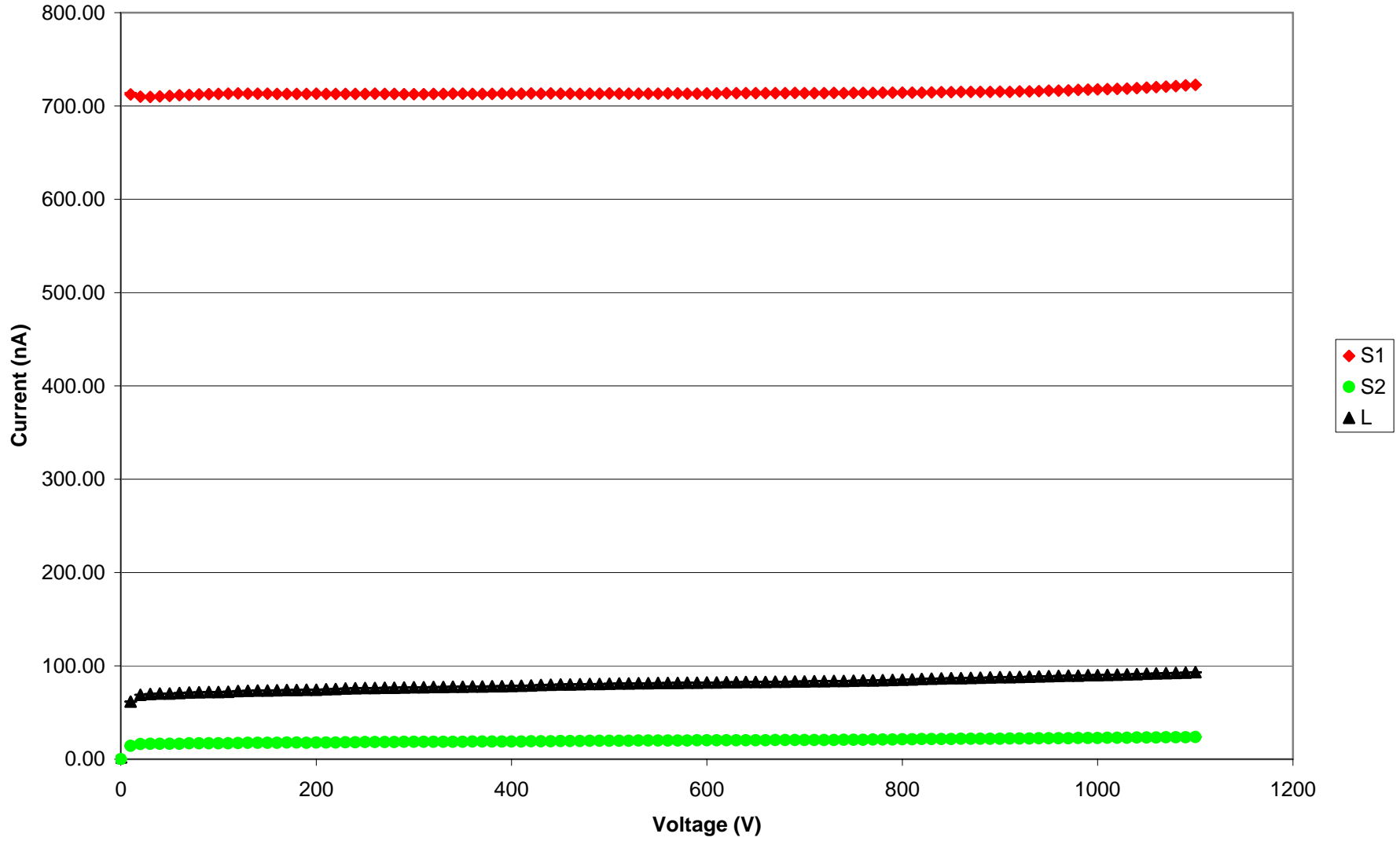
Type / Silicon Method:
N-type / MCz



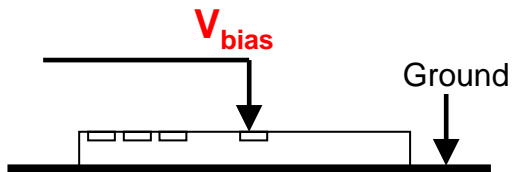
Sensor:
2553-13



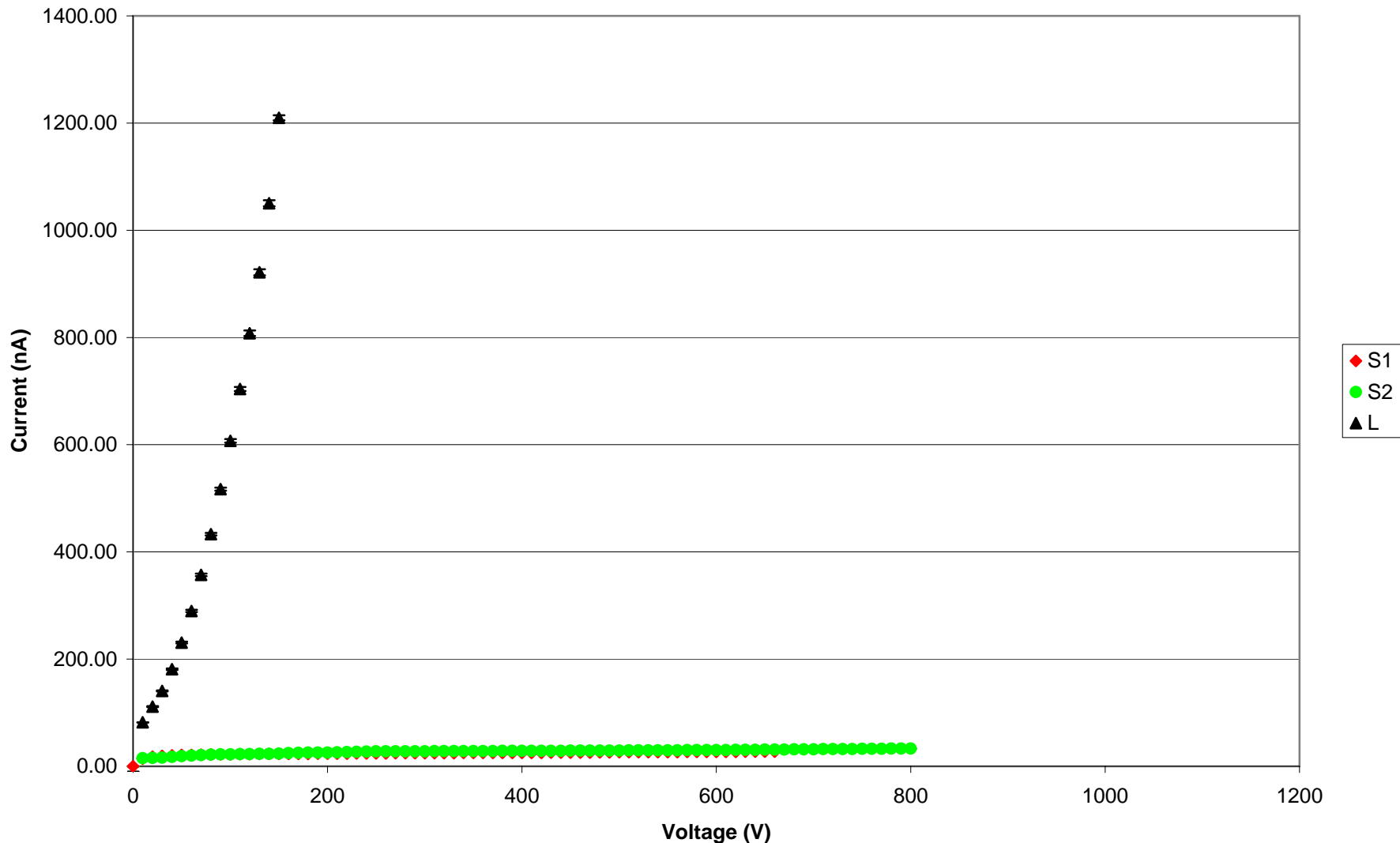
Type / Silicon Method:
P-type / MCz



Sensor:
2553-14

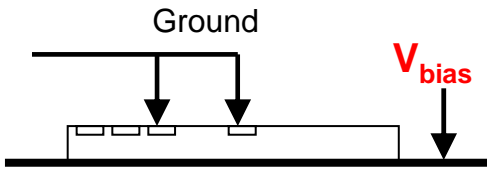


Type / Silicon Method:
P-type / MCz



Effect of Irradiation

- 4 Sensors were irradiated
 - Dose: $1E15$ n equ / cm^2
 - Pre-irradiation measurements performed by Sadia
- When returned, we did not know which sensors were which...



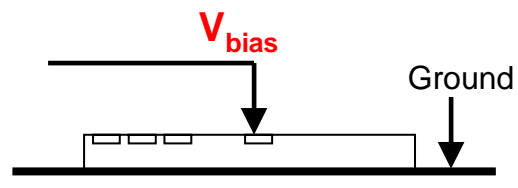
Pre-Irradiation



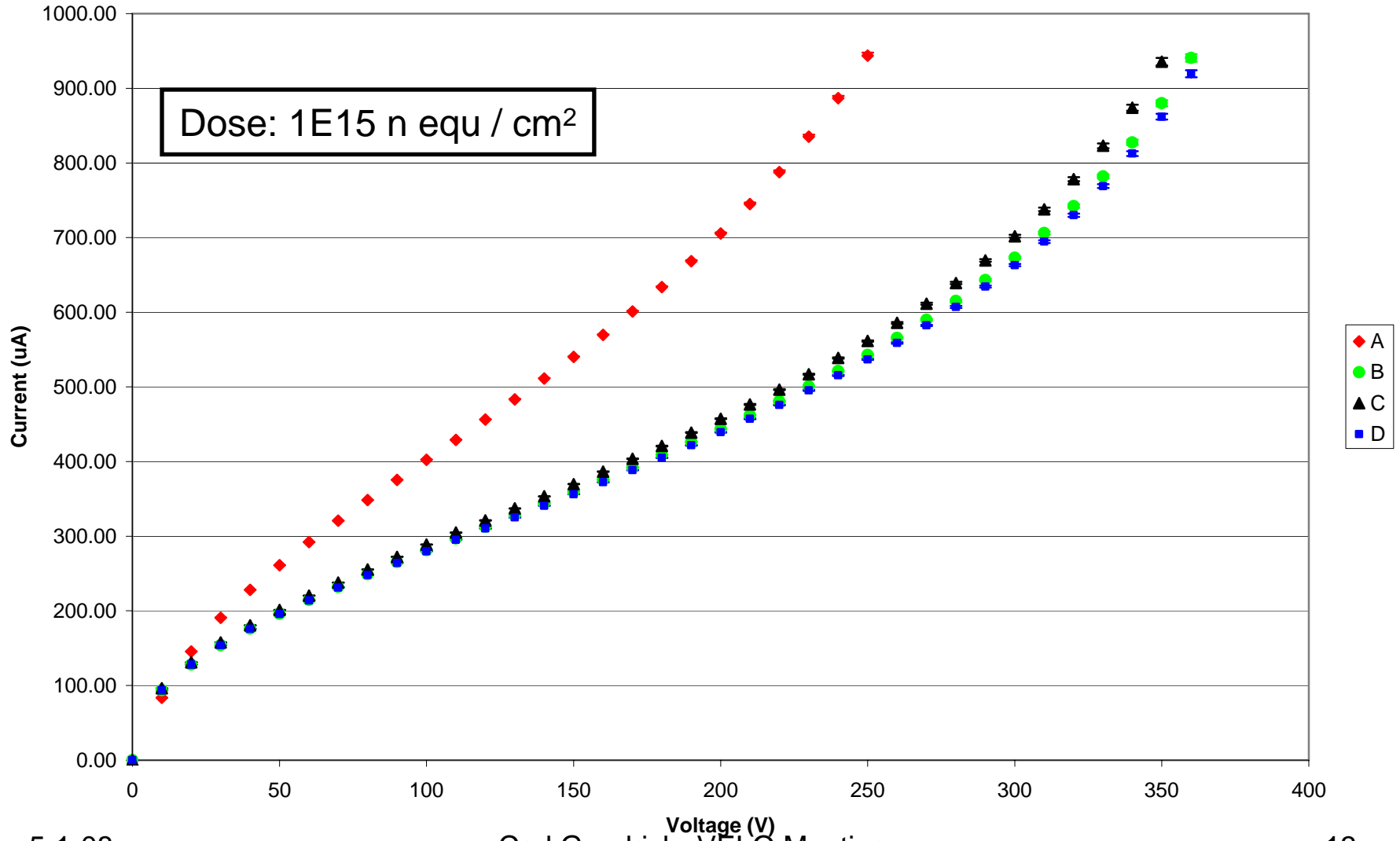
Irradiated Sensors- Results

- The current increased by approximately 5 orders of magnitude.
- To protect the sensors, we limited the current to 1mA.
 - The irradiated sensors obtained this current between 250V and 400V.
- One sensor showed a significantly greater current, suggesting it *might* be the MCz sensor.

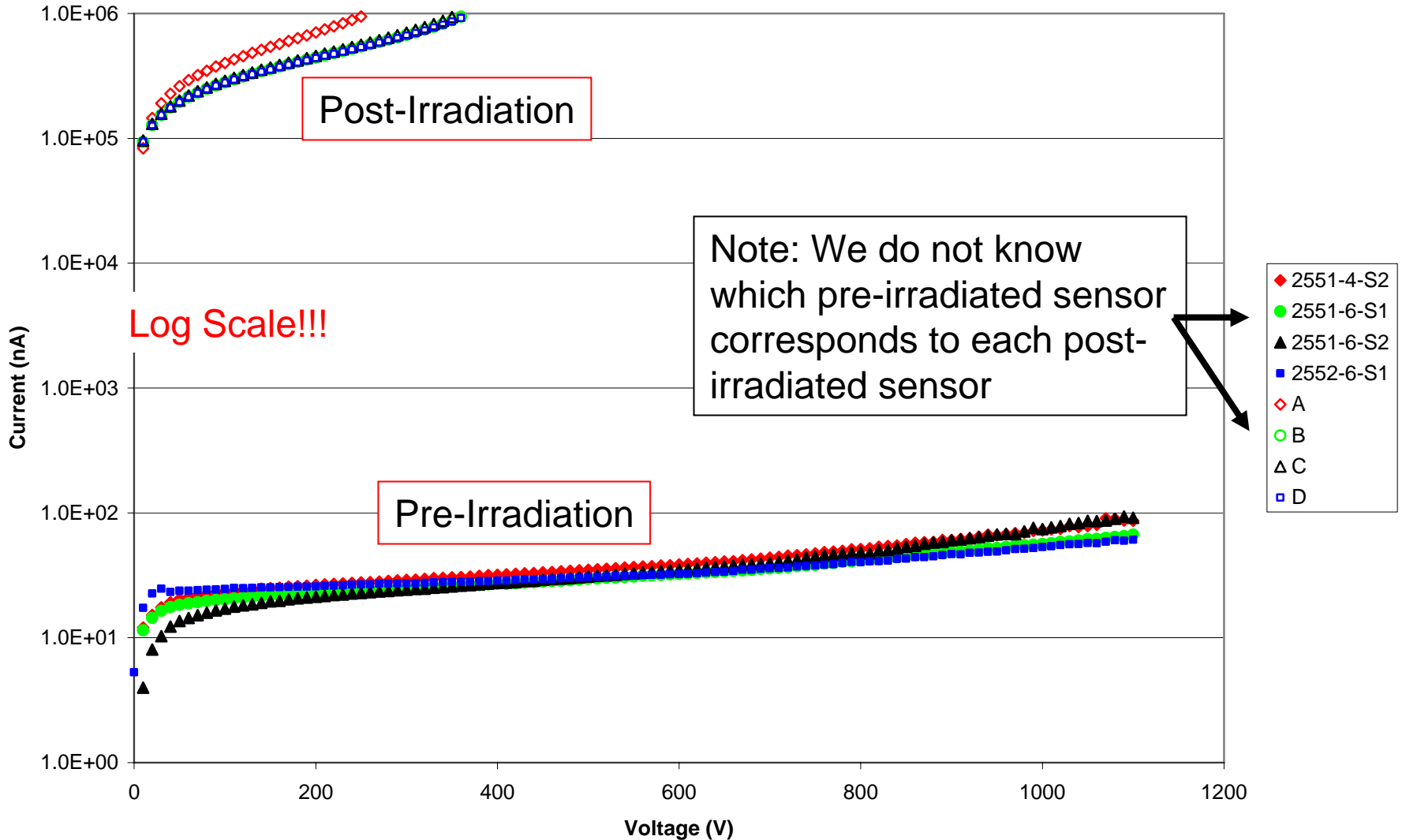
Type / Silicon Method:
P-type / MCz (1) and FZ (3)



Post-Irradiation

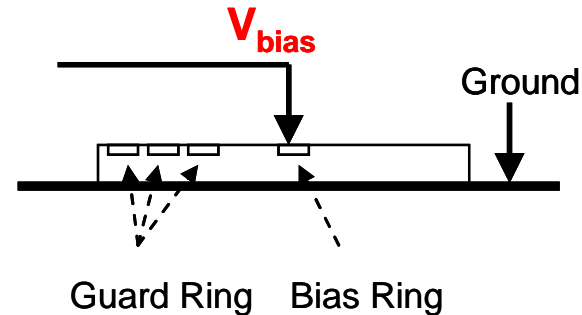
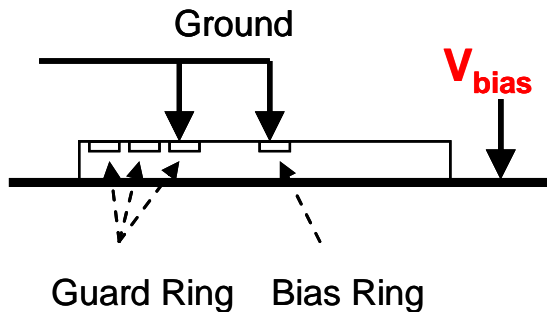


Pre- and Post-Irradiation



Backup Slides

What circuit to use?



- Biasing the rubber pad increases the current, especially after 600V.
- Also increases the uncertainty in the measurement

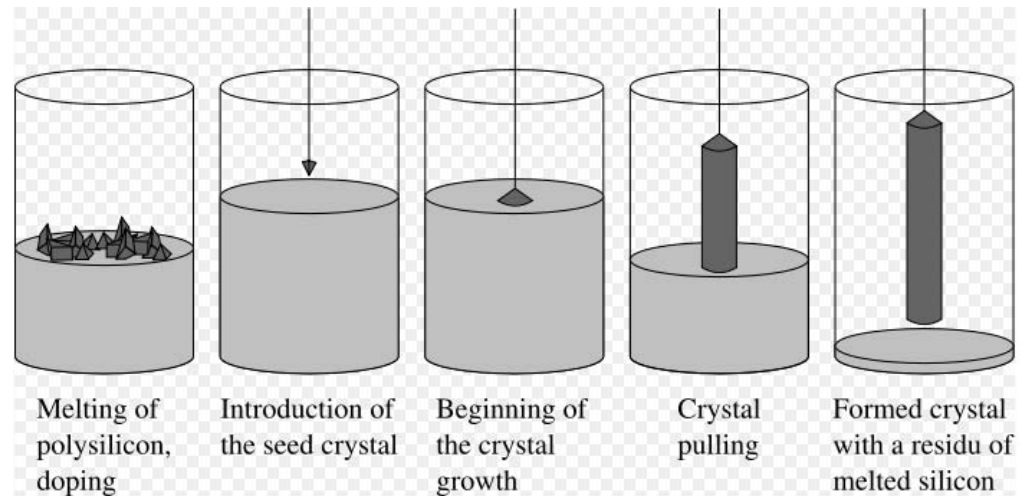
- Cannot measure the Guard Ring and Bias Ring currents separately.

Czochralski (Cz) Method

Method for forming single silicon crystals

- Process:

- Melt polysilicon
- Introduce a single silicon “seed” and pull up slowly
- Silicon freezes at the solid-liquid interface to form a single crystal



Czochralski (Cz) Method

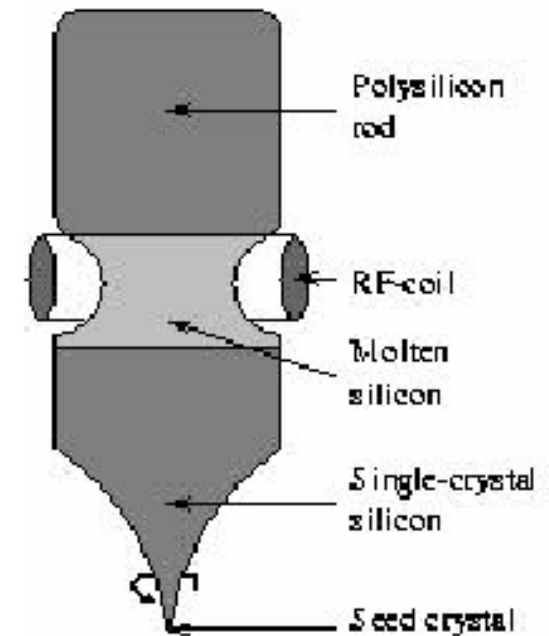
- High concentrations of oxygen impurities
 - Increases the radiation hardness (RH)
 - Good- needed due to high radiation
 - Decreases the resistivity
 - Bad- high resistivity needed for detectors
- Increase the resistivity by applying a strong magnetic field during growth
 - Magnetic Czochralski Method (MCz)

Float Zone (FZ) Method

Another method for forming single silicon crystals

- Process

- Place a single silicon “seed” below a polysilicon rod
- RF coil (heater) moves upward
- Silicon melts and refreezes as a single crystal



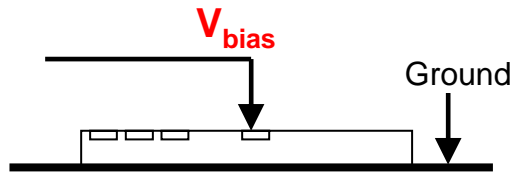
Float Zone (FZ) Method

- Low concentration of impurities
 - Low radiation hardness (RH)
 - Bad
 - High resistivity
 - Good
- To increase RH, add:
 - Oxygen (DOFZ)
 - Nitrogen (FZN)

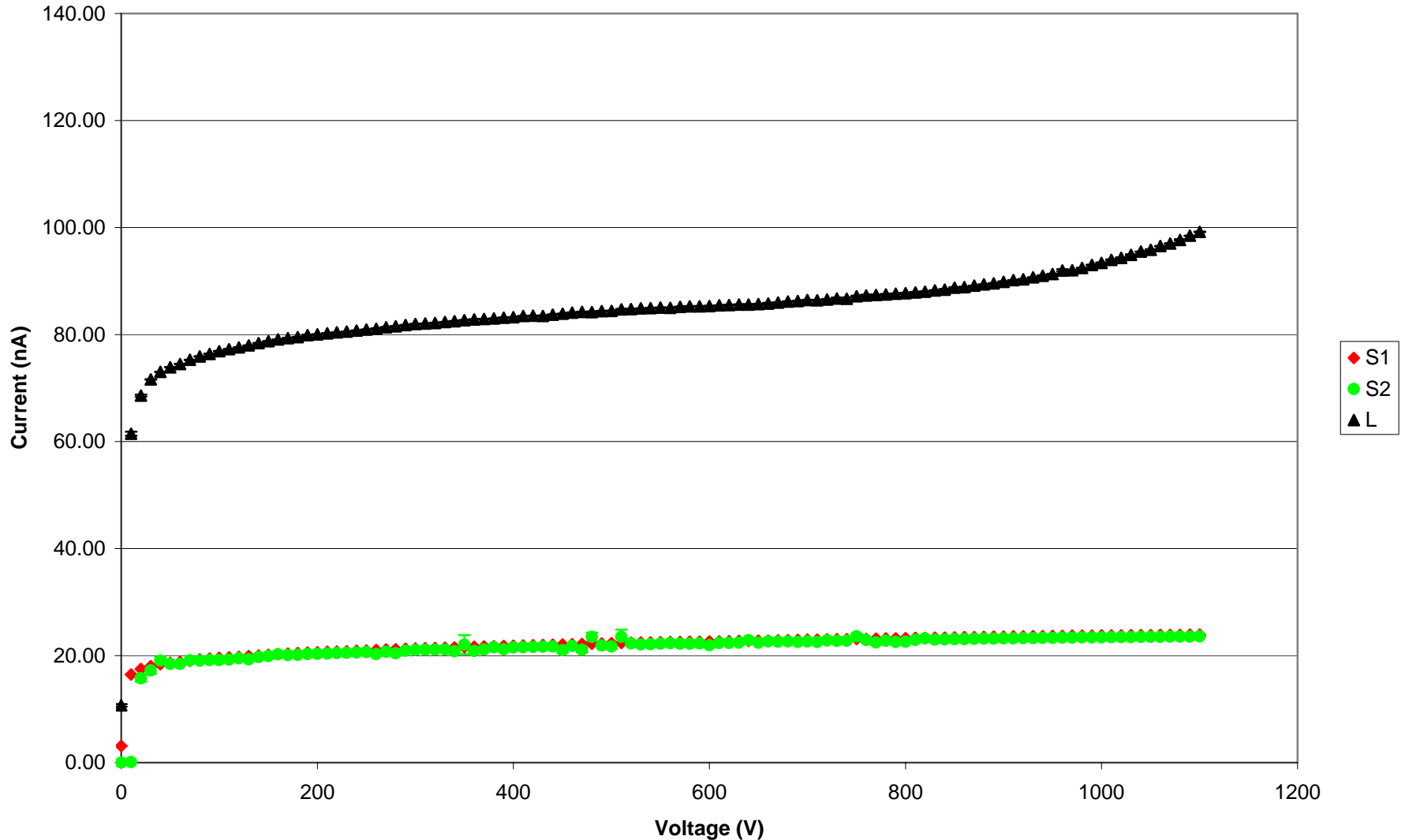
References

- Panja-Riina Luukka. Ph.D. Thesis. “CHARACTERIZATION OF CZOCHRALSKI SILICON DETECTORS.” INTERNAL REPORT SERIES. Helsinki Institute of Physics.
- Gianluigi Casse's PhD thesis
 - <http://hep.ph.liv.ac.uk/~gcasse/thesis.html>

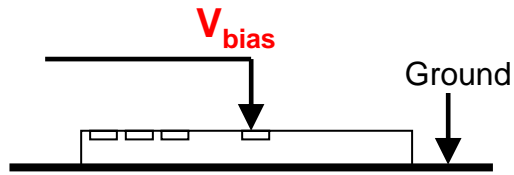
Sensor:
2535-7



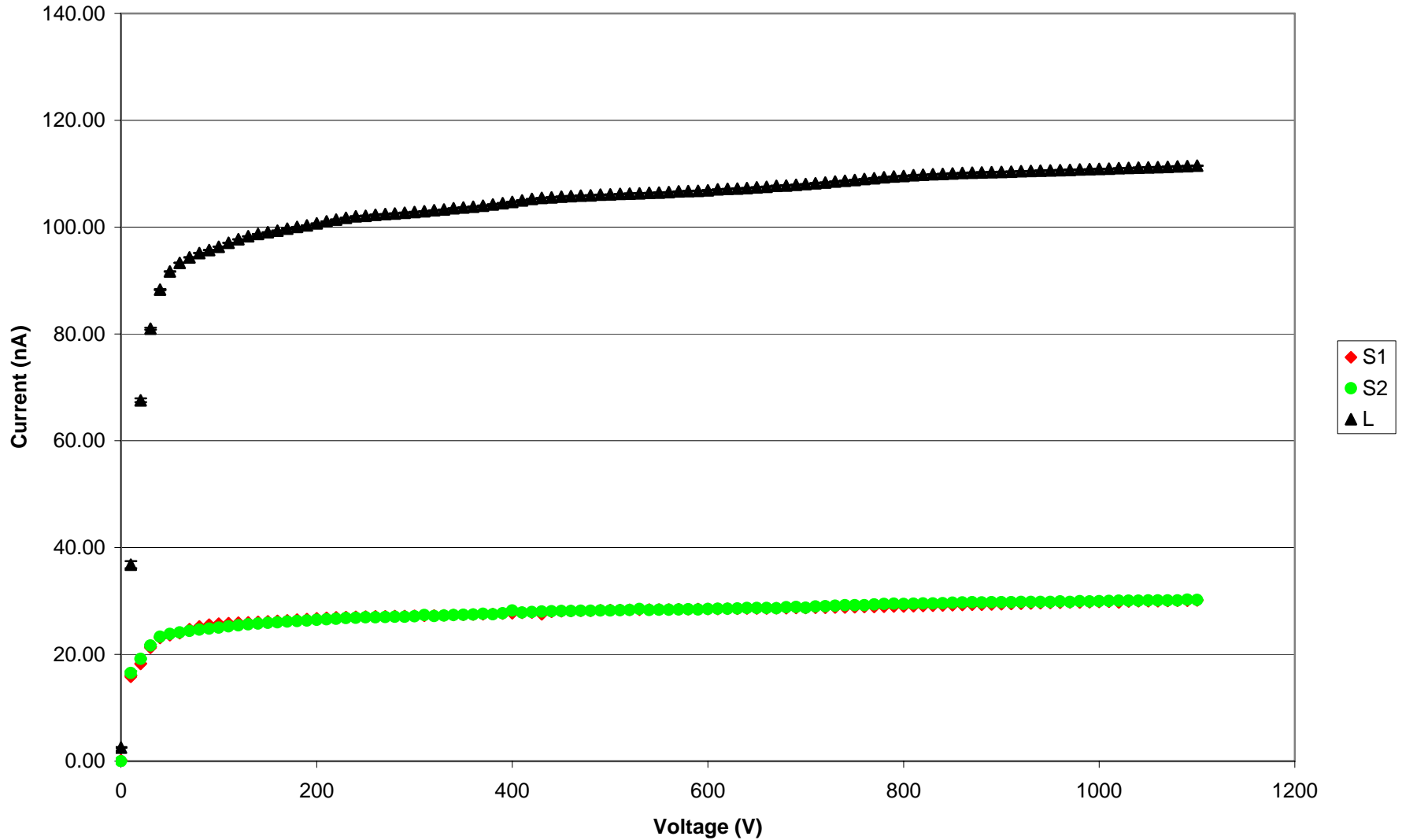
Type / Silicon Method:
N-type / FZ



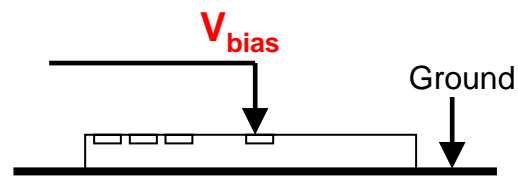
Sensor:
2552-9



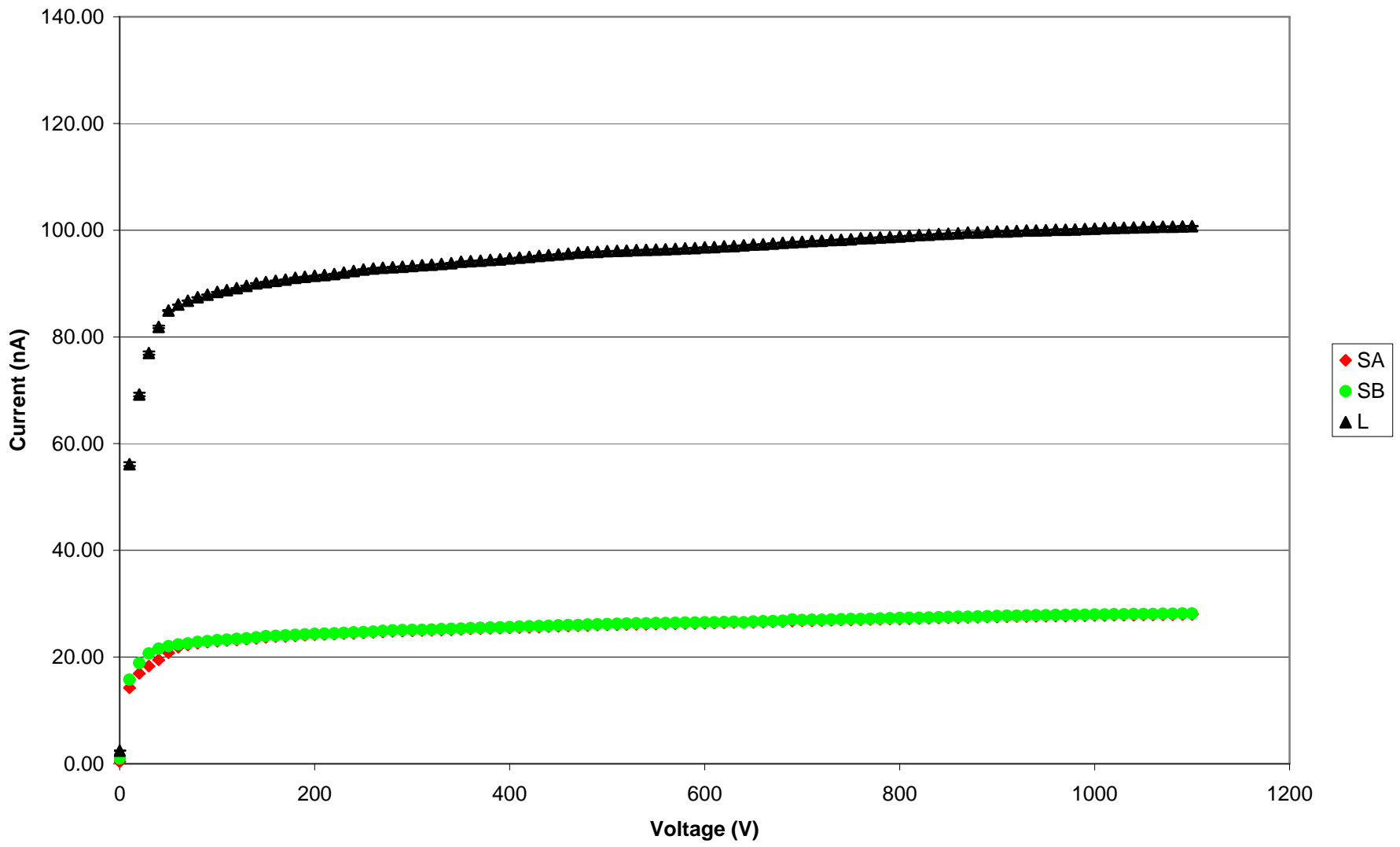
Type / Silicon Method:
N-type / MCz



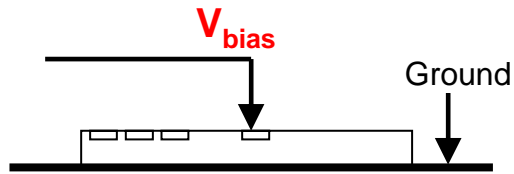
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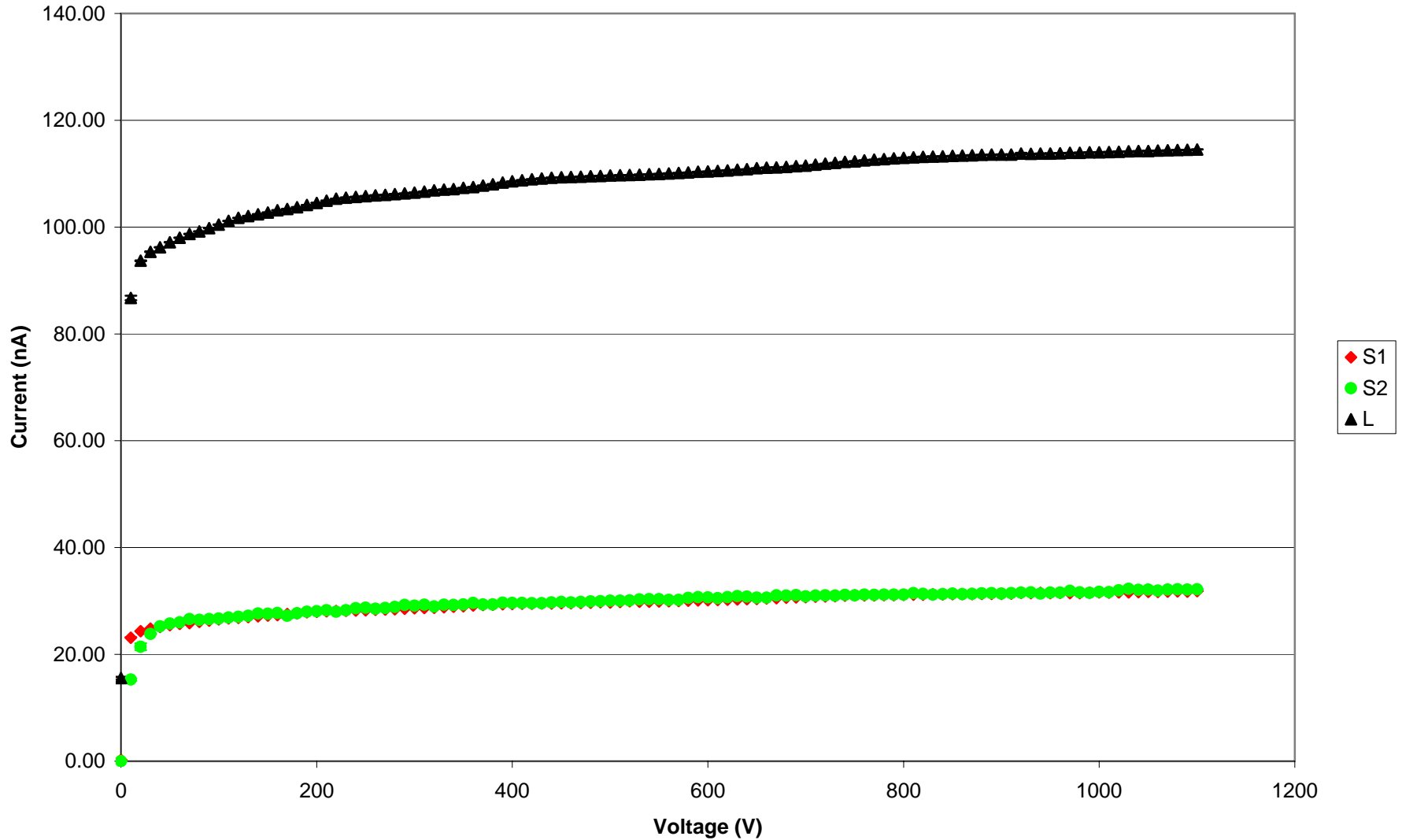
Type / Silicon Method:
N-type / MCz



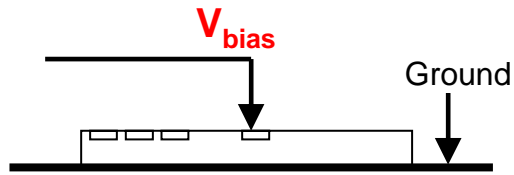
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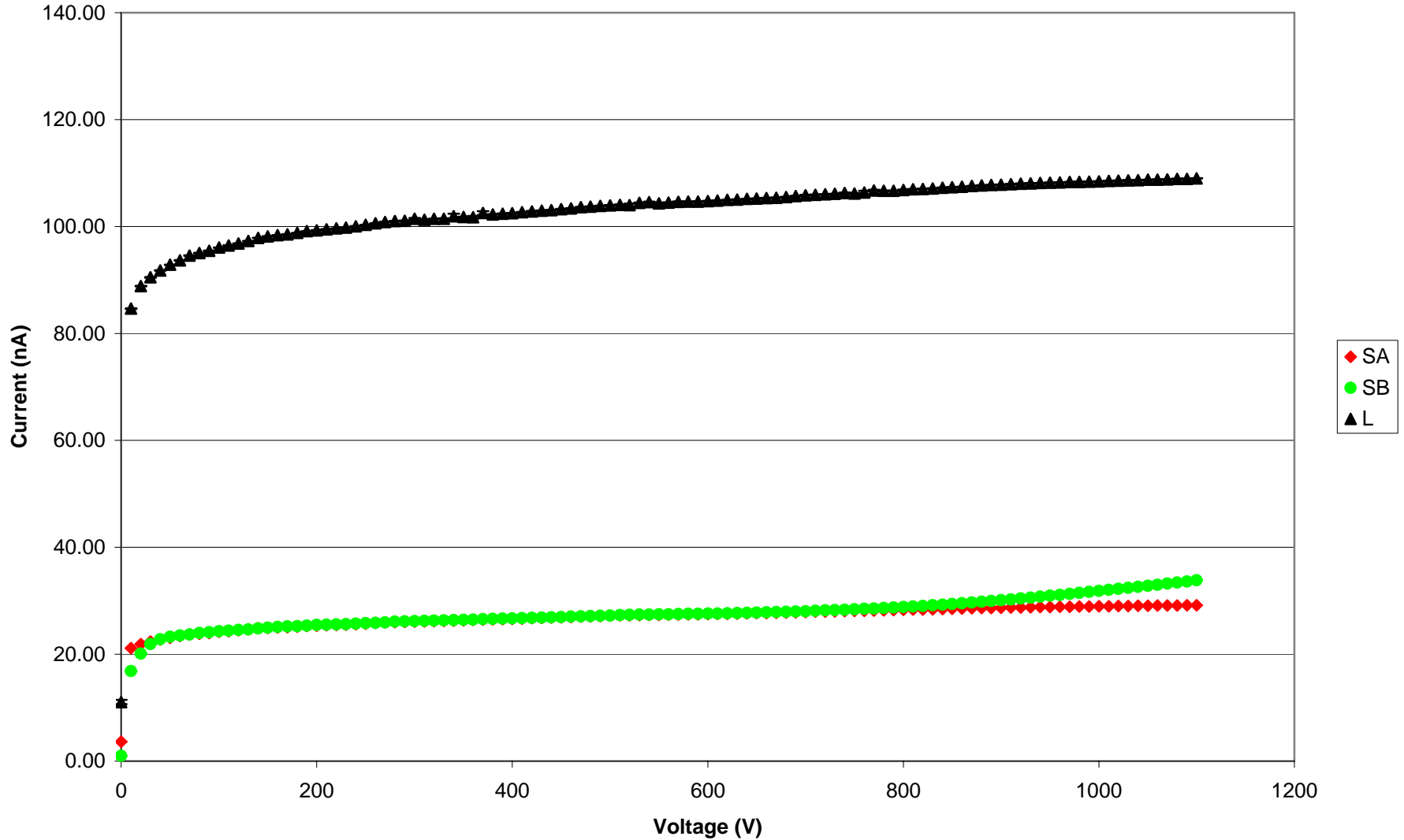
Type / Silicon Method:
N-type / MCz



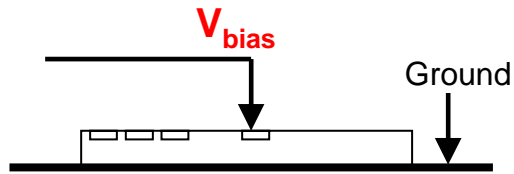
Sensor:
2552-14



Type / Silicon Method:
N-type / MCz



Sensor:
2553-12



Type / Silicon Method:
P-type / MCz

