Sensor: 104858, Date: 15/07/2023
IV-Characterisation: 104858_HPK

LCD-HGCAL Sensor Testing

October 24, 2023

- Measurement: 104858_HPK
- **Date: 15/07/2023**
- **Test station: HPK**
- Chuck temperature: 25.0 degrees Celsius

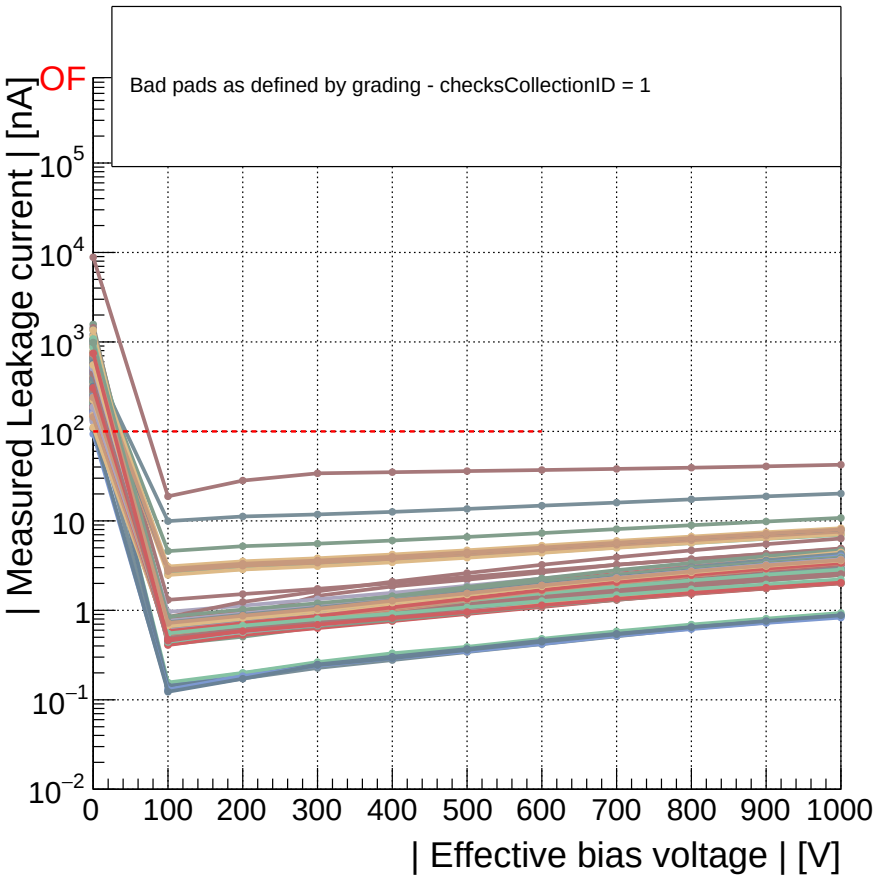
- **Sensor: 104858**
- Size: 8 inches
- N_{cells}: 199
- Doping: p-type, p-stop: comm.
- active thickness: 300 μm
- Irradiation: 0 neq/cm^2

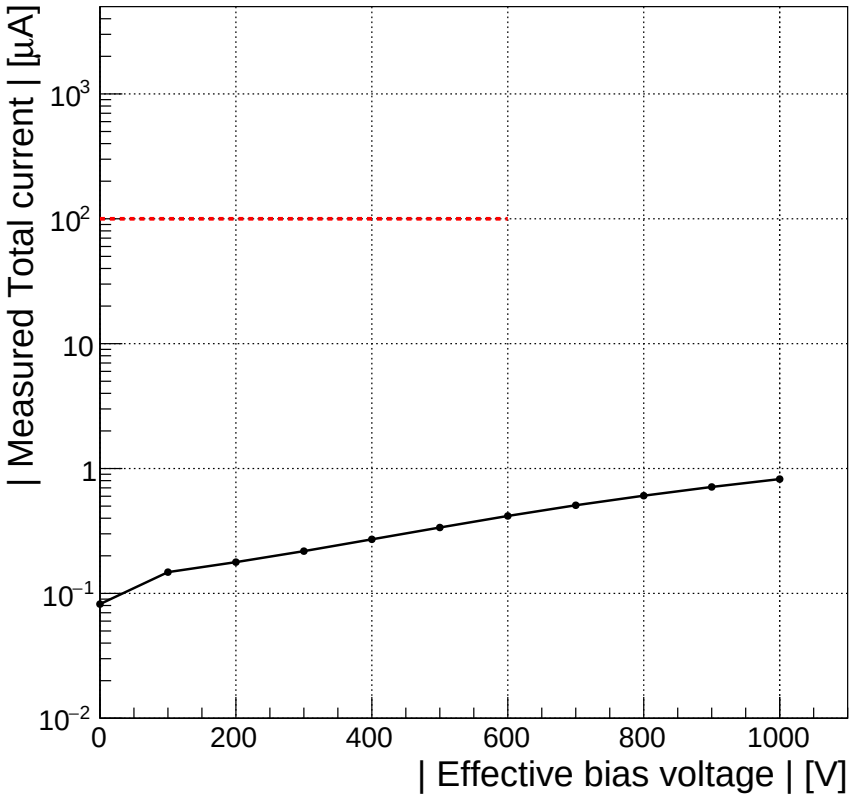
Location of intermediate files

- (raw) measurement file:
  / eos/ user/ h/ hgsensor/ HGCAL_test_results/ Results/ Hamamatsu/ HPK_Upload/ Full/ S15591-01/ 2309/ OBA49339/ IV/ 8-198-300F-L6-P5295-02-104858-0-IV.txt
- formatted file:
  / home/ data/ hgsensor_iv/ Hamamatsu_Preproduction_OBA49339/ formatted/ 104858_HPK.txt
- voltage-corrected file:
  / home/ data/ hgsensor_iv/ Hamamatsu_Preproduction_OBA49339/ resistance_corrected/ 104858_HPK.txt
- temperature-scaled file:
  / home/ data/ hgsensor_iv/ Hamamatsu_Preproduction_OBA49339/ temperature_scaled/ 104858_HPK.txt

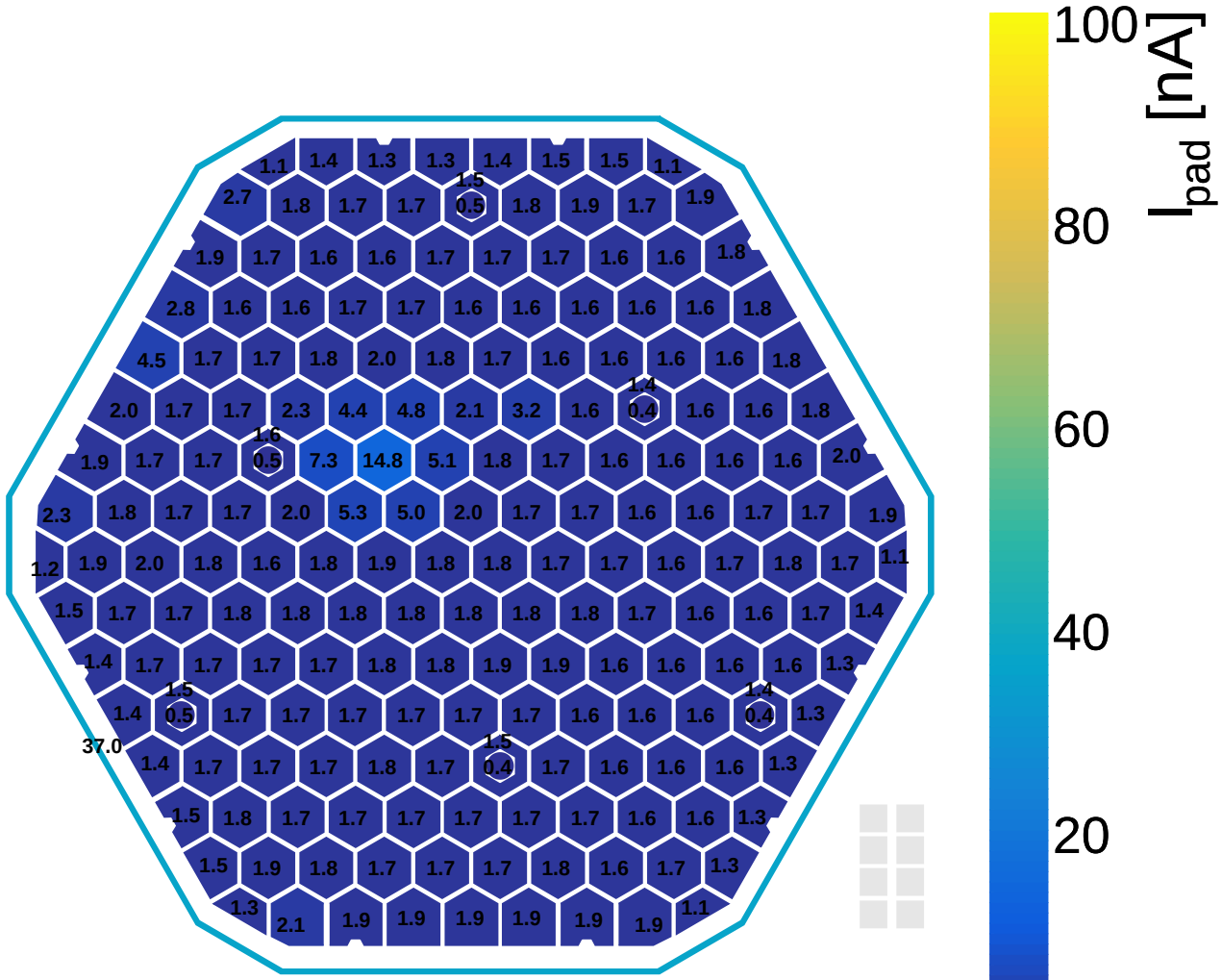
All-cells IV

- Left: IV curves for all channels. Shown in the legend are only the curves for pads defined as bad by the grading performed with the indicated checksCollectionID.
- Right: Total current measured as the mean of the last 50 channels (if available - otherwise all). Absolute values are used both for voltages and currents.





Hexplots, interpolated bias voltage of 600 V



IV Grading of the sensor

Info:

- Last measured voltage point: 1000.0 V;
- Expected depletion voltage for sensors of thickness 300 μm: 250 V; 250 x 1.5 = 375.0 V.
- IV scan performed well above 1.5 times the expected depletion voltage.

Grading:

- Sensor has been graded with checksCollectionID 1.
- Global characteristics:
  - Current at 600V I600 (normalised to 20 deg Celsius): <= 100 μA integrated over the sensor and guard rings: Passed
  - I800 < 2.5 x I600: Passed
  - Number of bad pads 0 <= 8 for full-sized sensors: Passed
  - Allowed number of adjacent bad pads <= 2: Passed
- Per-pad characteristics used to define bad pads if any of the following are met:
  - Current at 600V I600 (normalised to 20 deg Celsius) > 100 nA/pad: **0** pads, namely **[]**
  - I600 > 10 nA and I800 > 2.5 x I600: **0** pads, namely **[]**
  - I600 $\leq$ 10 nA and I800 > 25 nA: **0** pads, namely **[]**

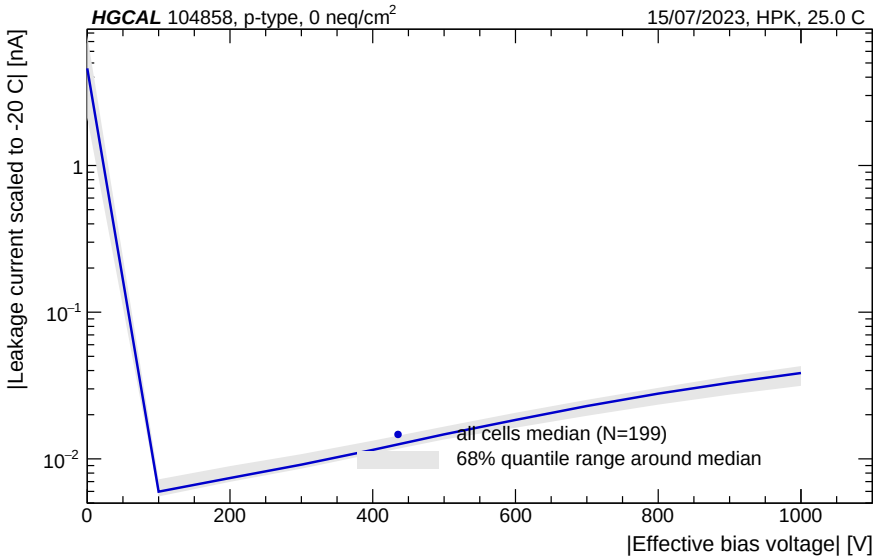
Sensor has PASSED the requirements.
WARNING: The following pads were masked at least once before or at 600V: [].

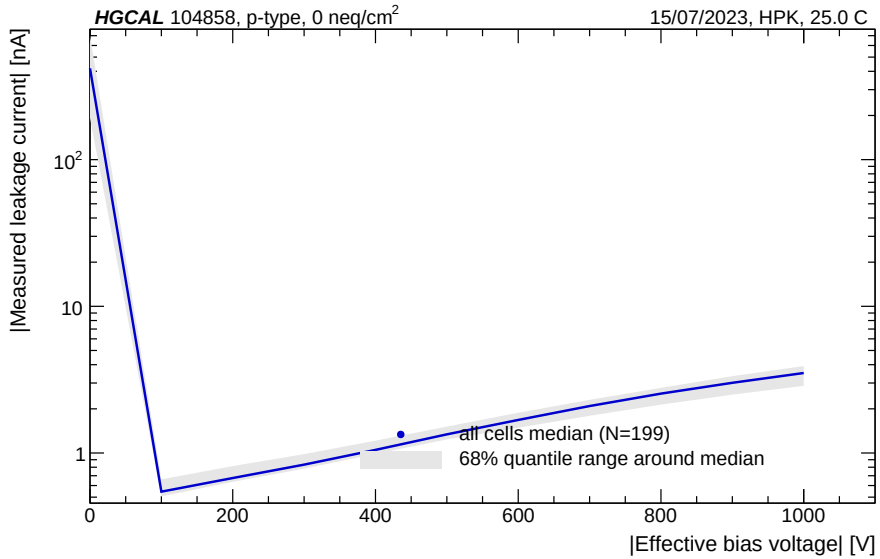
Median IV vs. Voltage

- All cells, independent of cell geometry, enter the median and inter-quantile range computation.
- Left: Currents are normalised to a reference temperature $T_{-20} = -20^{\circ}$ C, as stated in Equation 1.

$$I_{-20} = I_T \cdot \left(\frac{T_{-20}}{T}\right)^2 \cdot \exp\left(\frac{E_g}{2 \cdot k_b} \cdot \left(\frac{1}{T} - \frac{1}{T_{-20}}\right)\right) \quad (1)$$

- Right: Cell leakage current at 25.0° as measured, i.e. without temperature scaling.



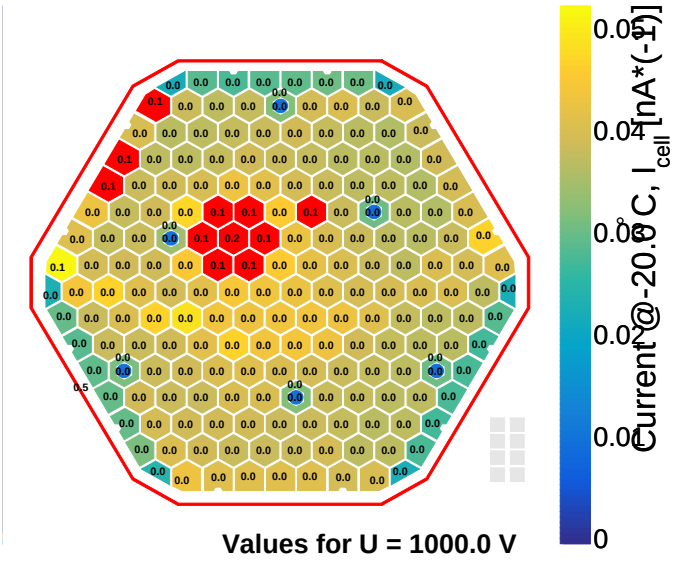


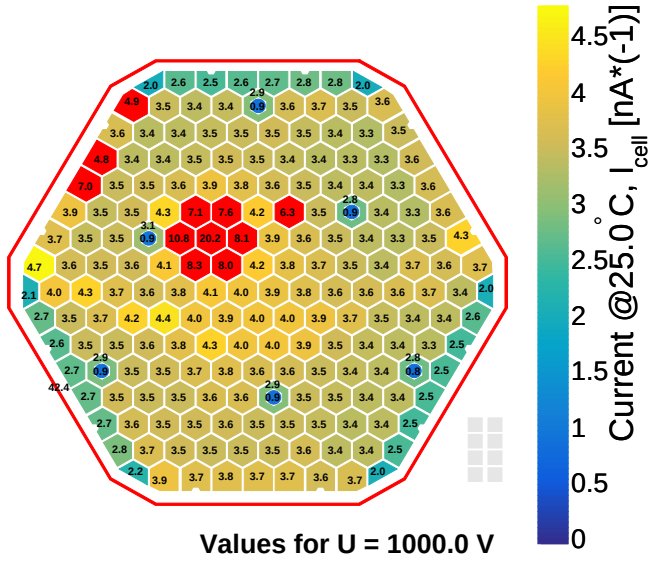
Leakage current Hexplots

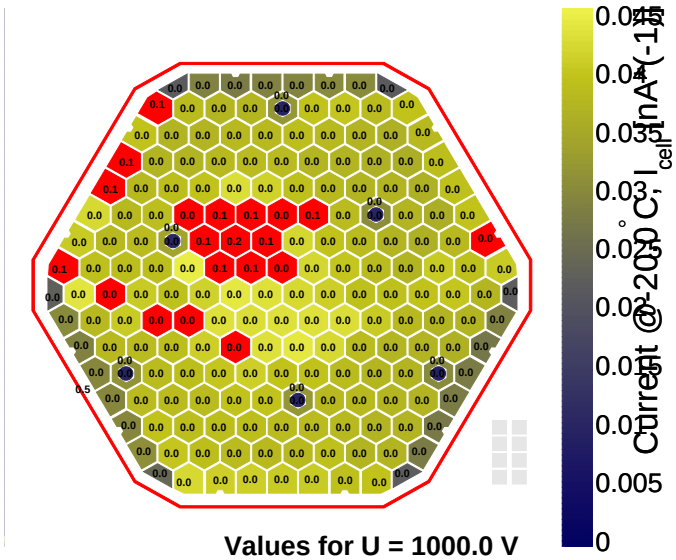
Description of the following figures:

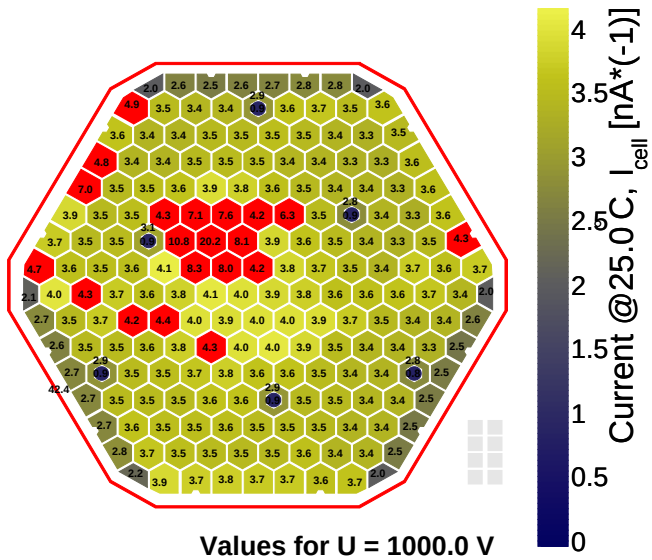
- The maximum of the color scale is defined to be the median of all cells connected to the sensor plus 1.5× the 50-84% inter-quantile range.
- Top-left: Currents are normalised to a reference temperature $T_{-20} = -20^{\circ}$ C, as stated in Equation 1.
- Top-right: Cell leakage current at 25.0° as measured, i.e. without temperature scaling.
- Bottom-left: Currents are normalised to a reference temperature $T_{-20} = -20^{\circ}$ C, as stated in Equation 1 with colour scale according to the highest bias voltage (absolute value).
- Bottom-right: Cell leakage current at 25.0° as measured, i.e. without temperature scaling with colour scale according to the highest bias voltage (absolute value).

Hexplots, nominal bias voltage of 1000.0 V

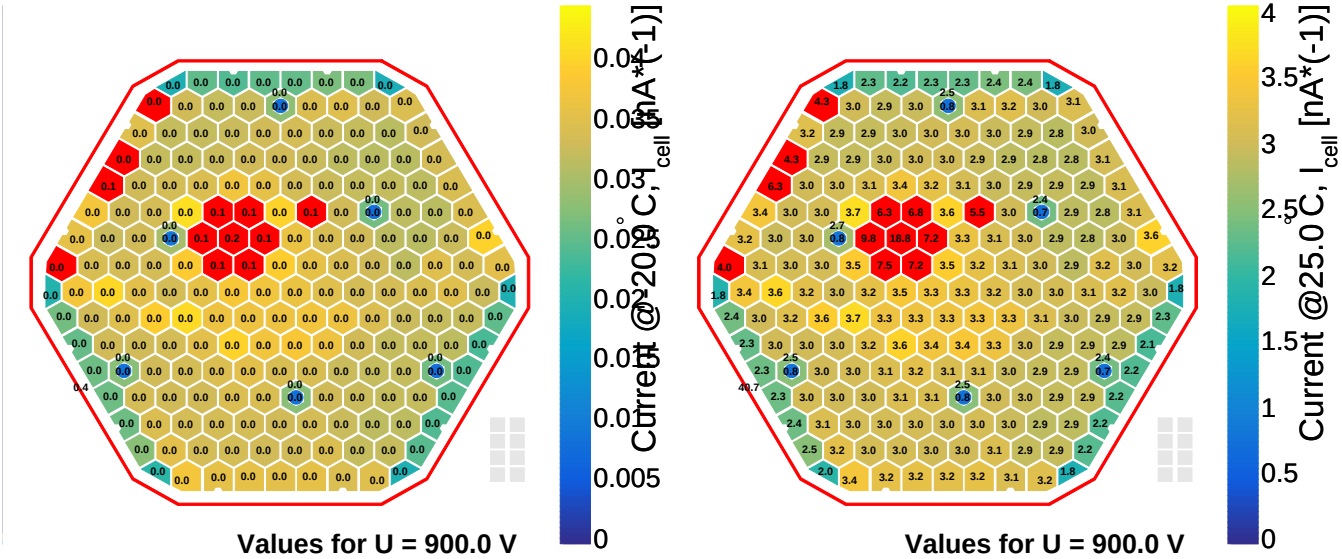


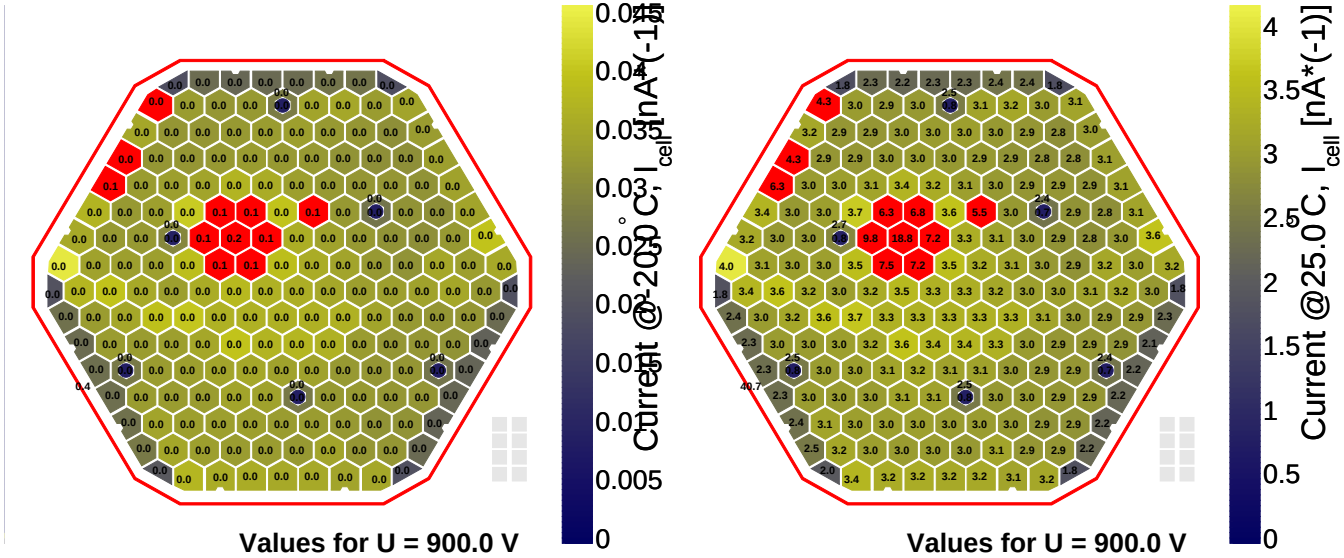




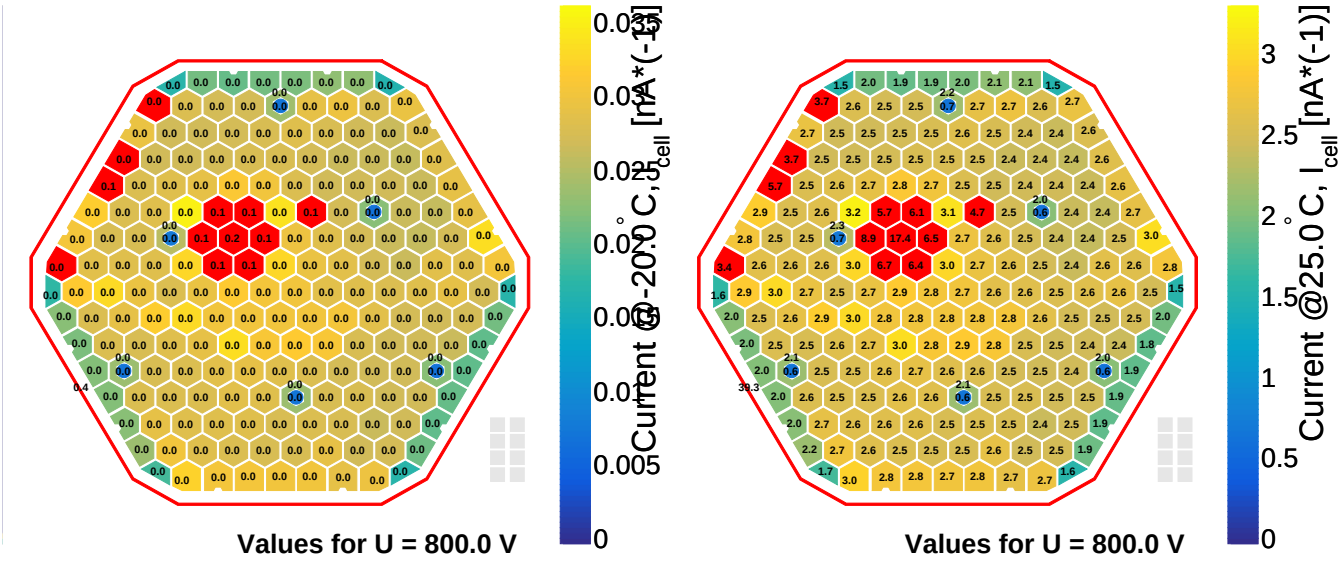


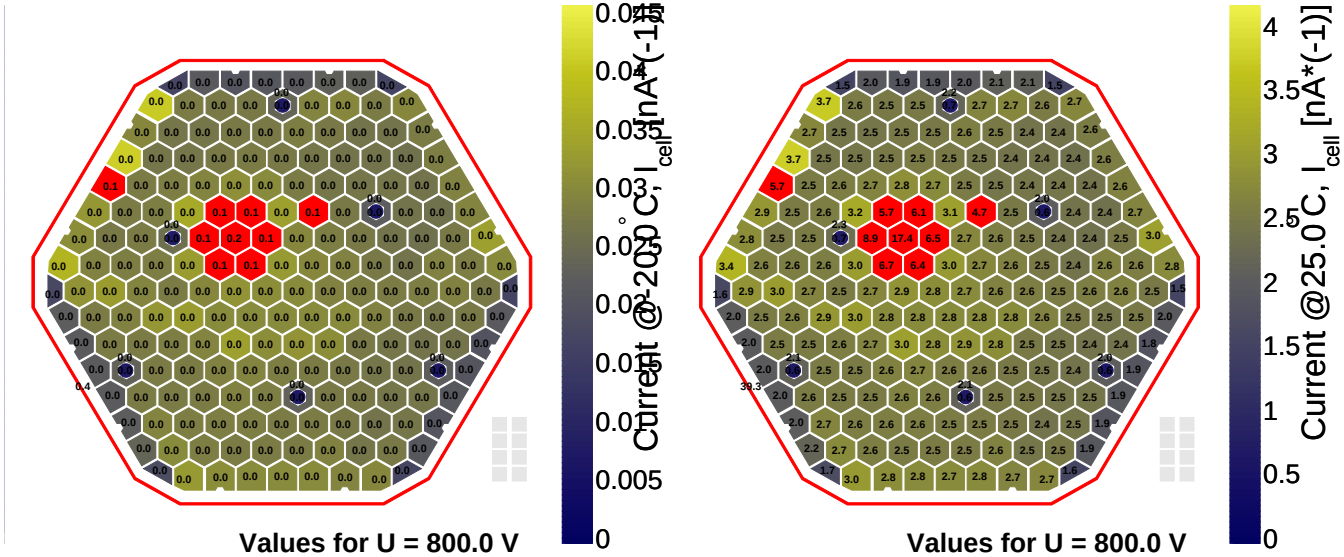
Hexplots, nominal bias voltage of 900.0 V



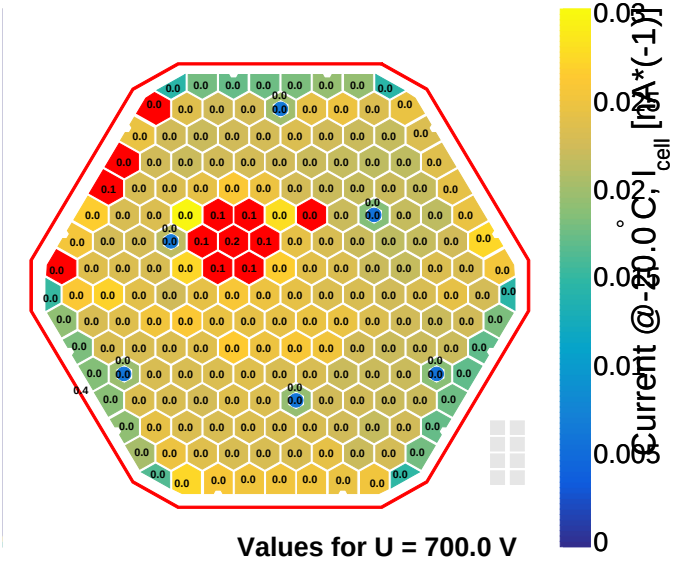


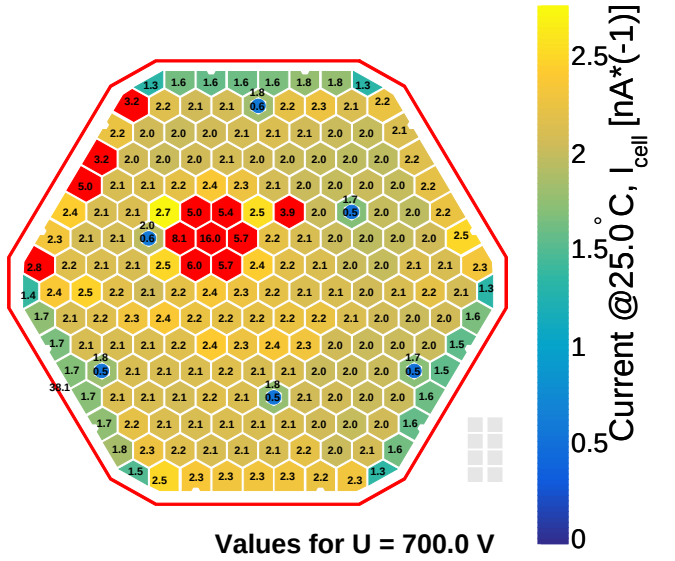
Hexplots, nominal bias voltage of 800.0 V

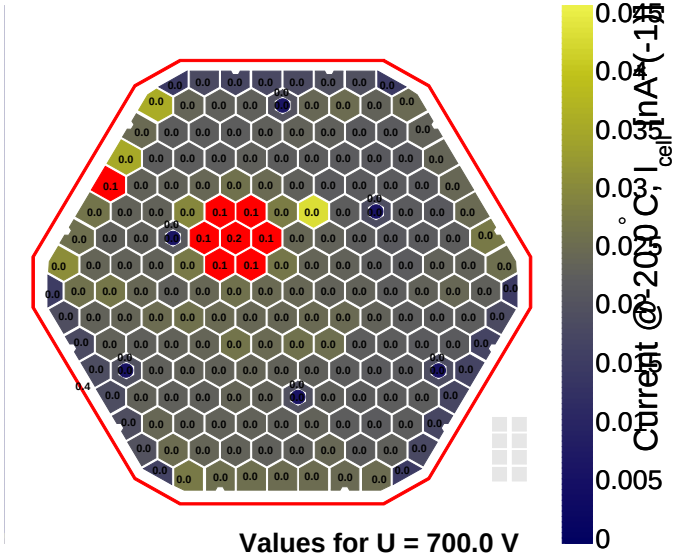


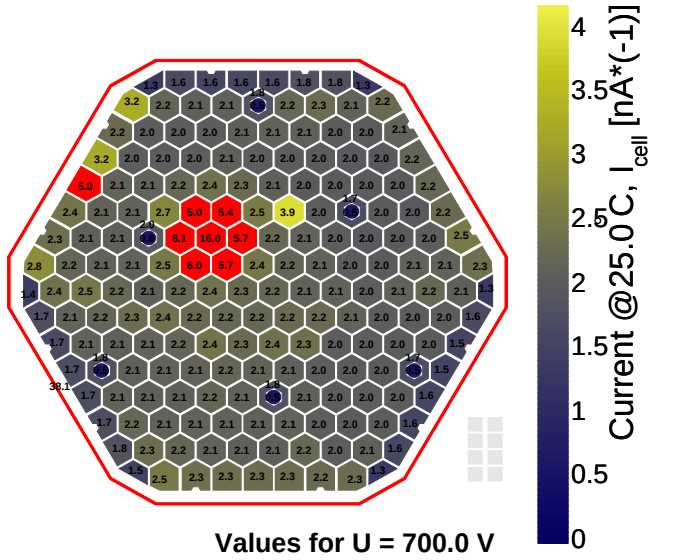


Hexplots, nominal bias voltage of 700.0 V

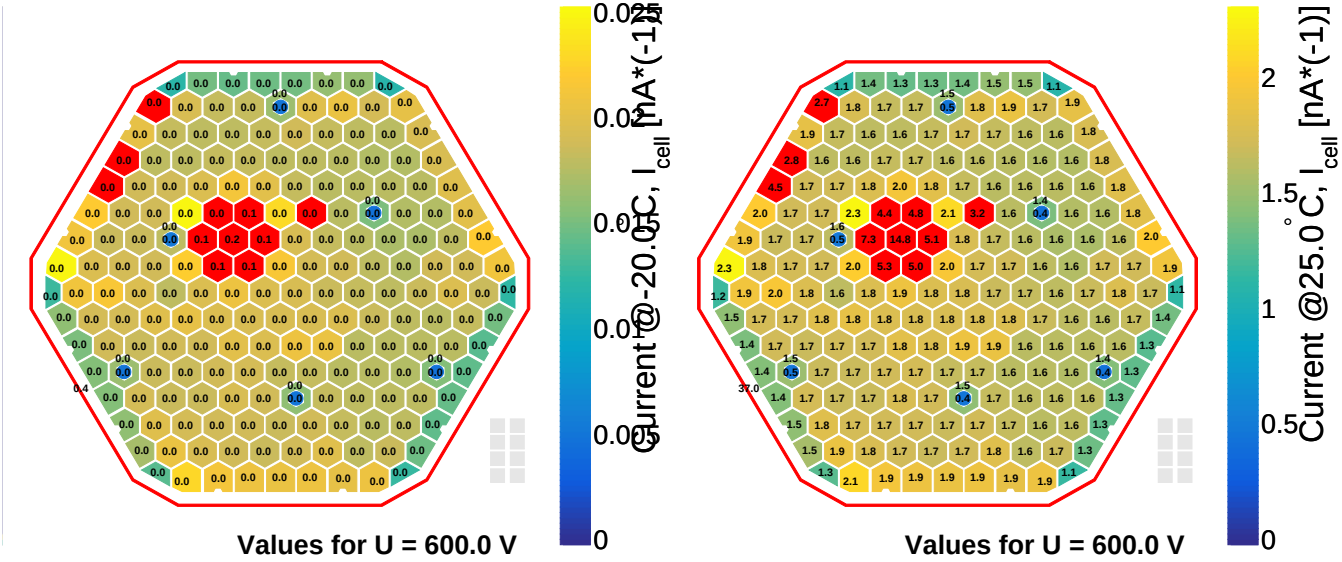


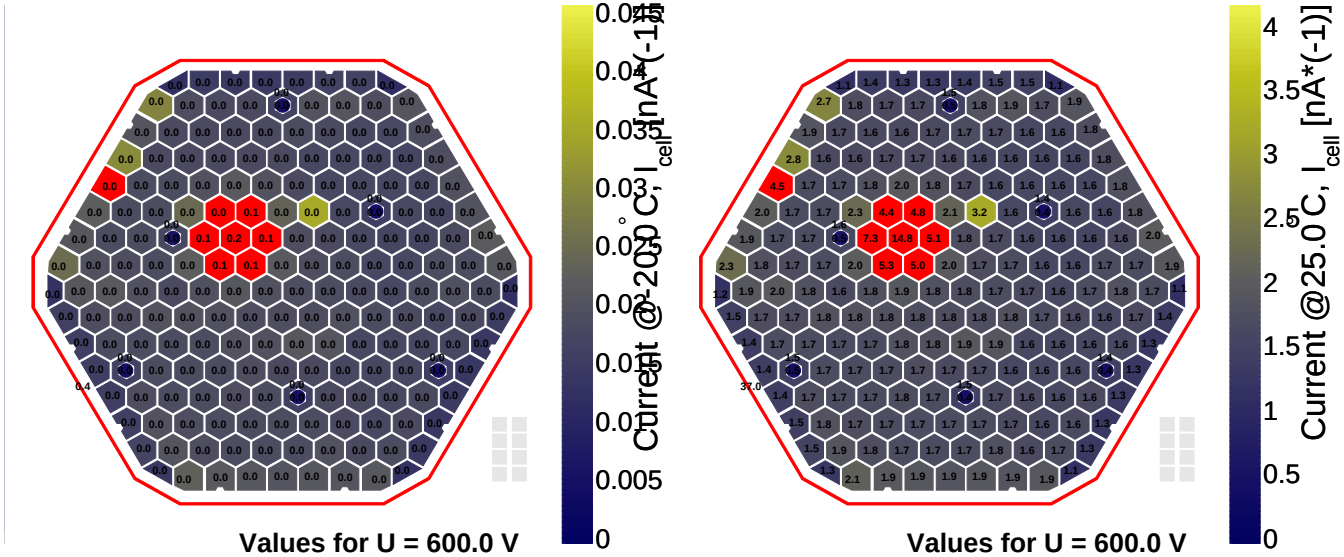




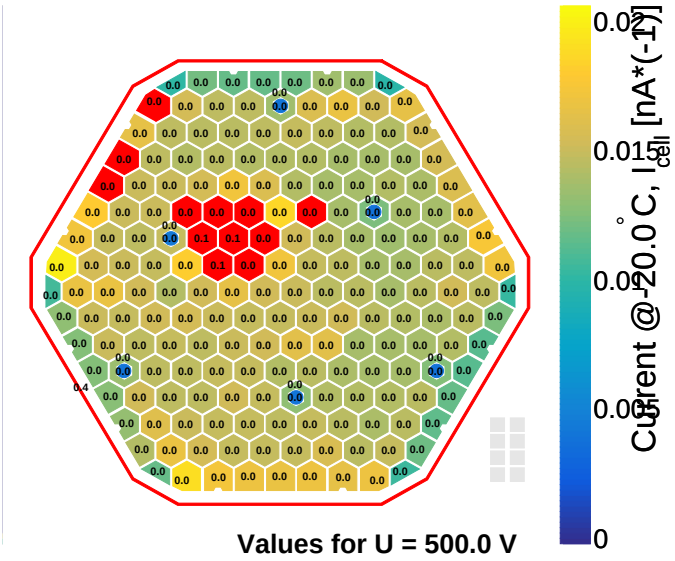


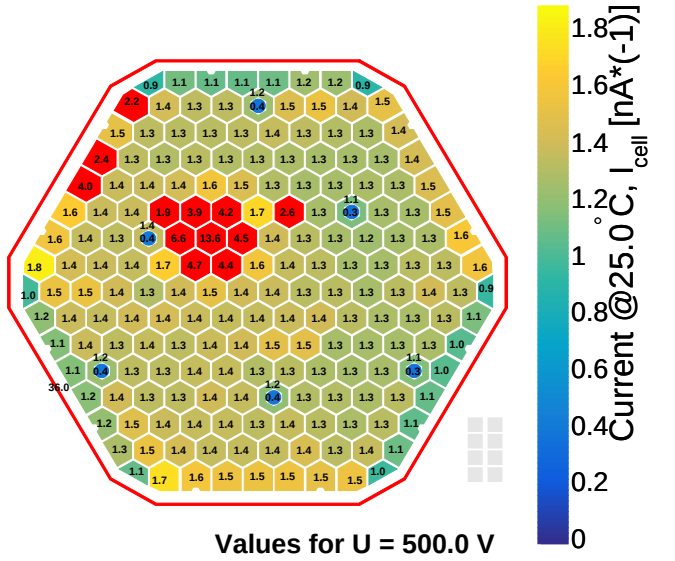
Hexplots, nominal bias voltage of 600.0 V

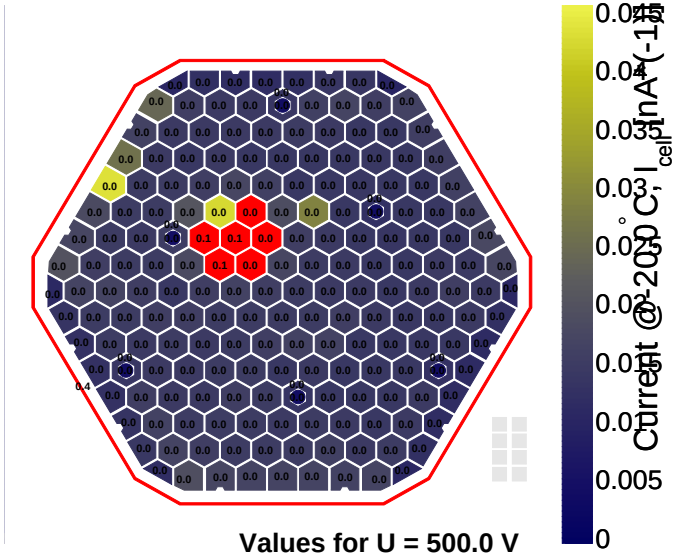


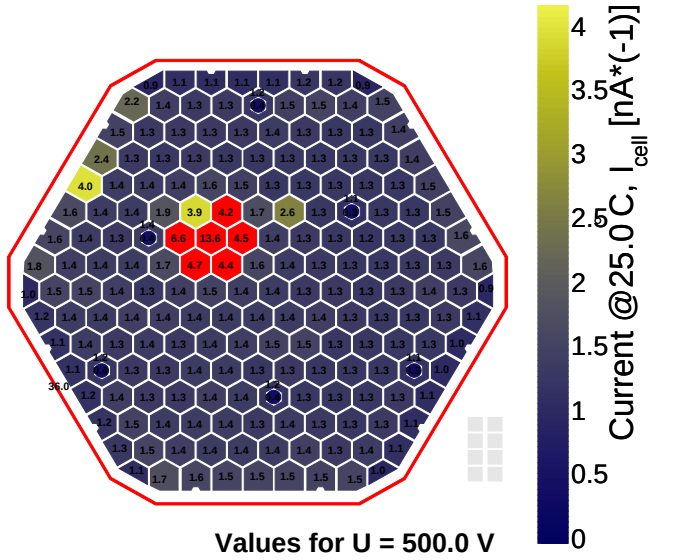


Hexplots, nominal bias voltage of 500.0 V

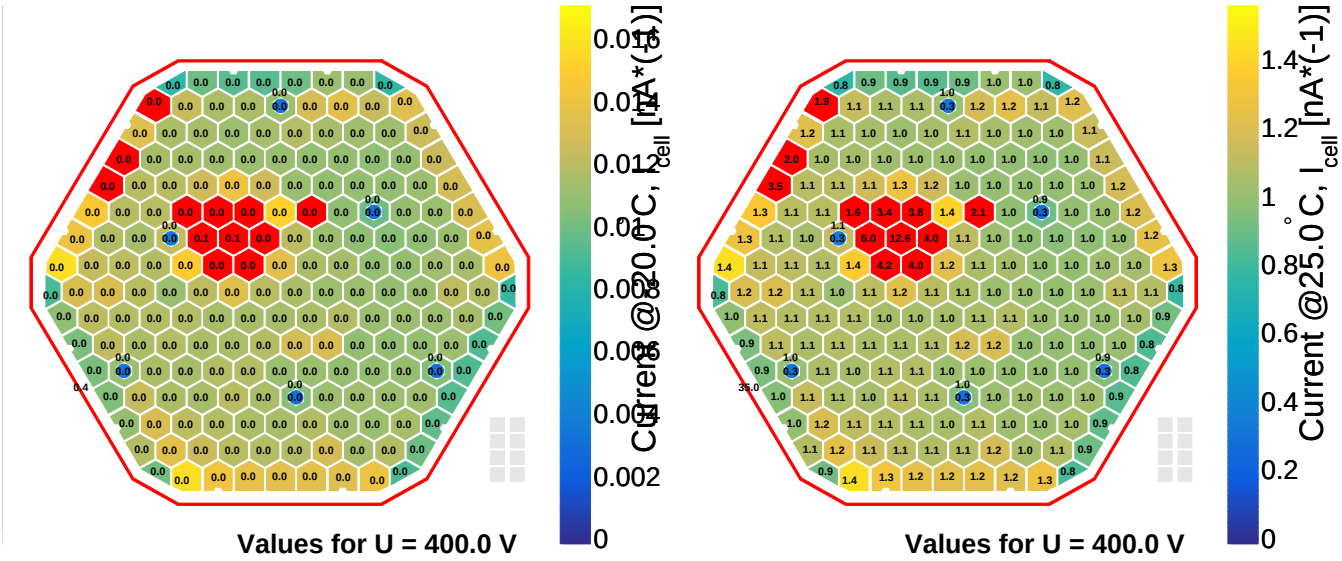


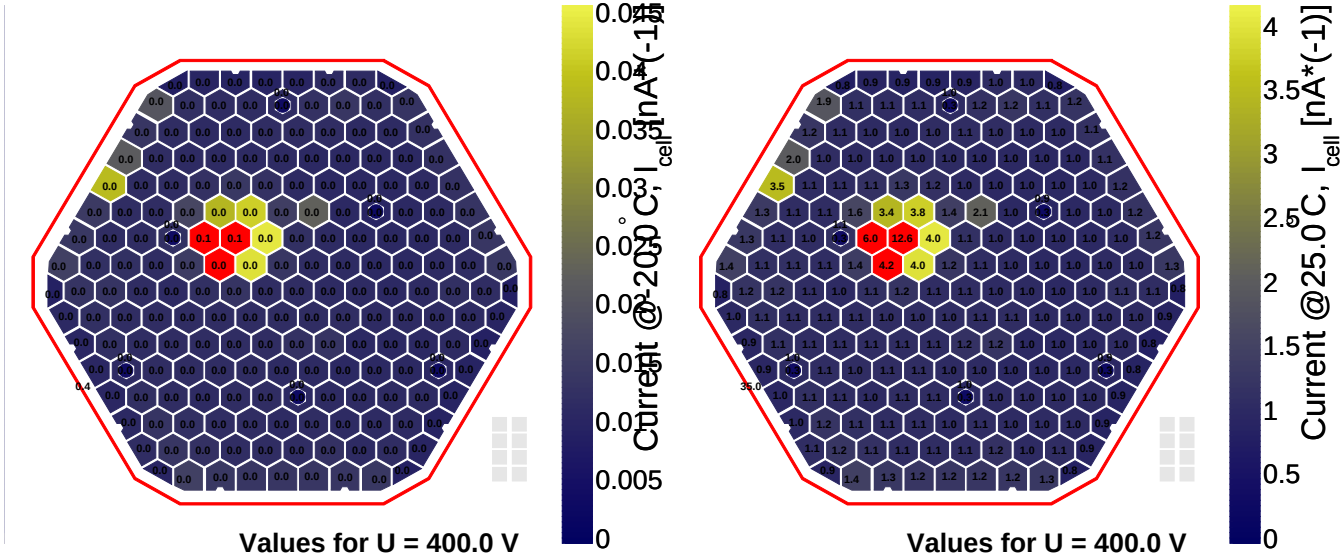




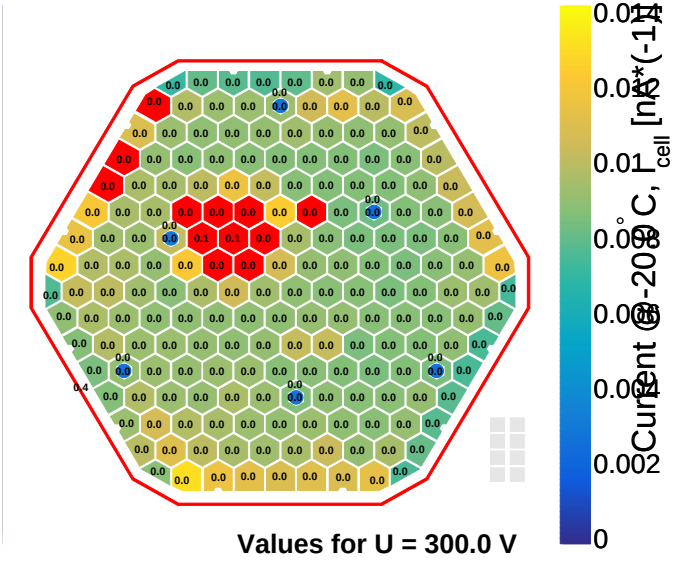


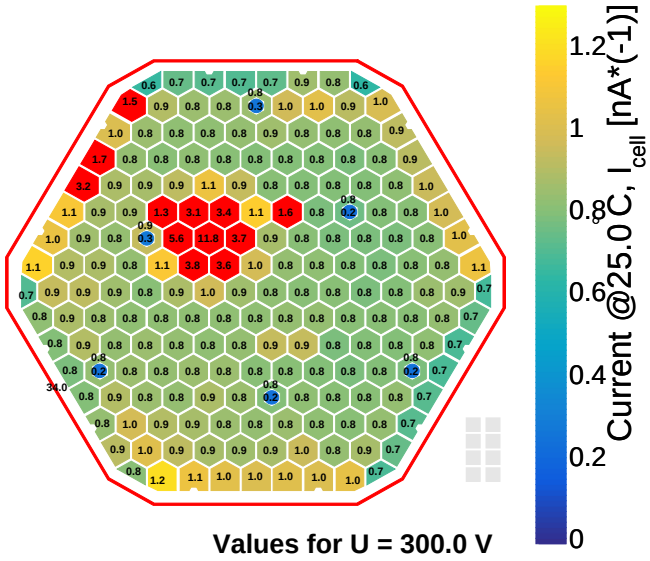
Hexplots, nominal bias voltage of 400.0 V

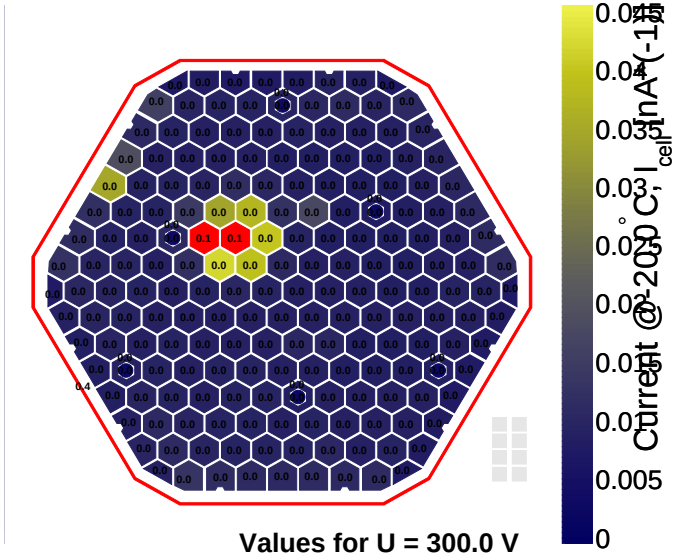


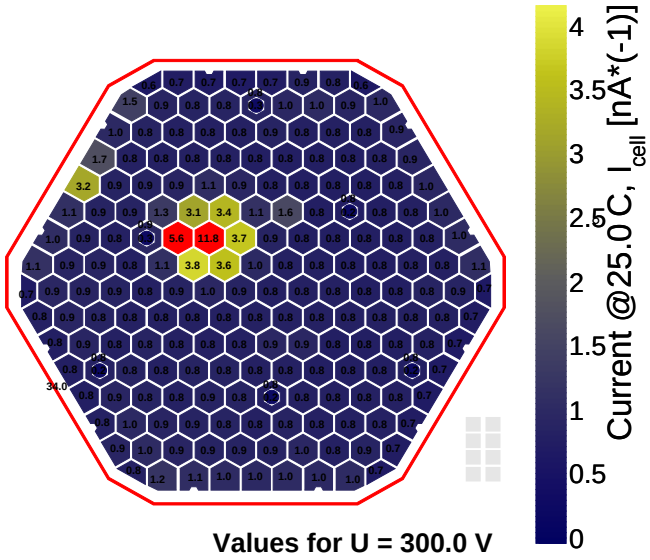


Hexplots, nominal bias voltage of 300.0 V

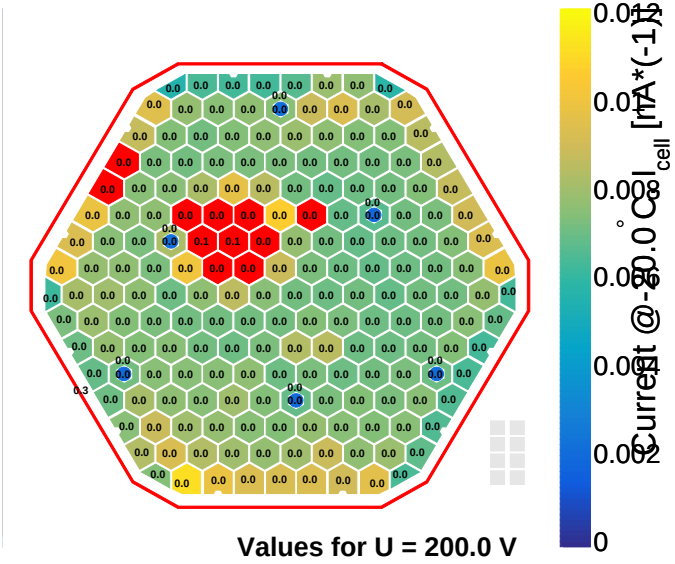


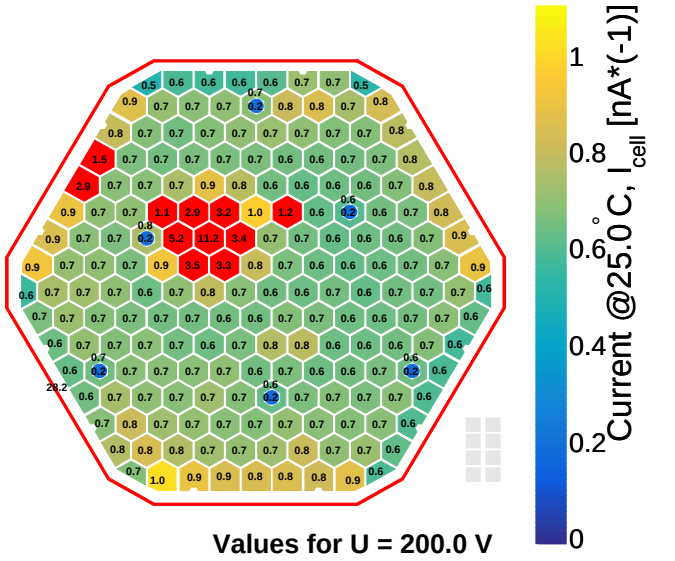


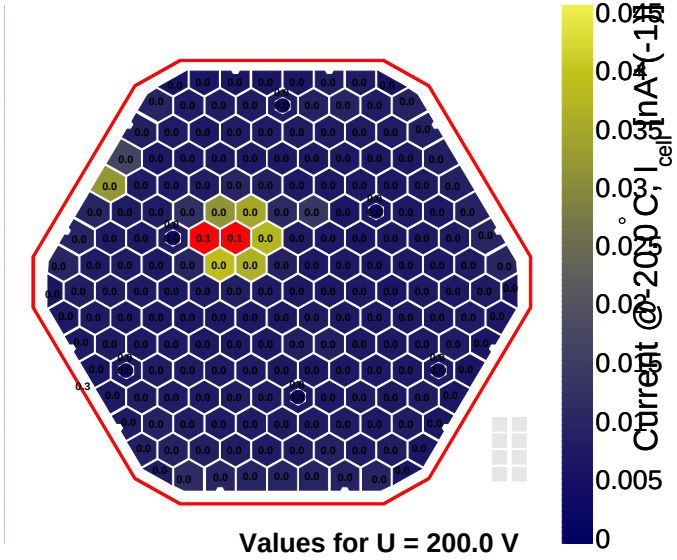


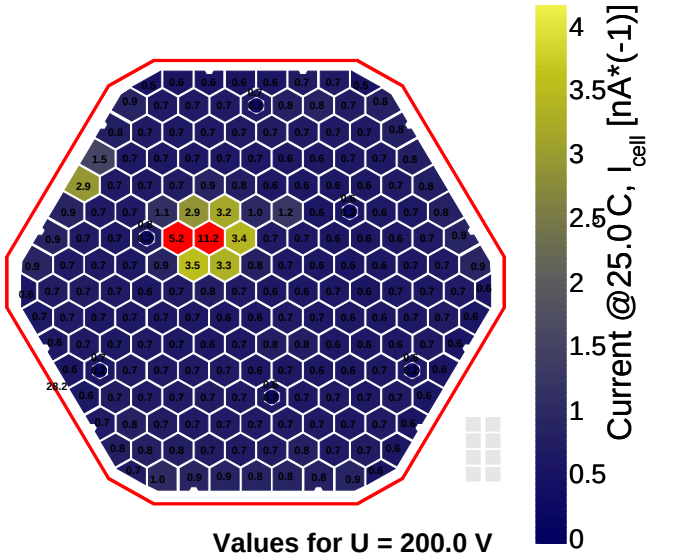


Hexplots, nominal bias voltage of 200.0 V

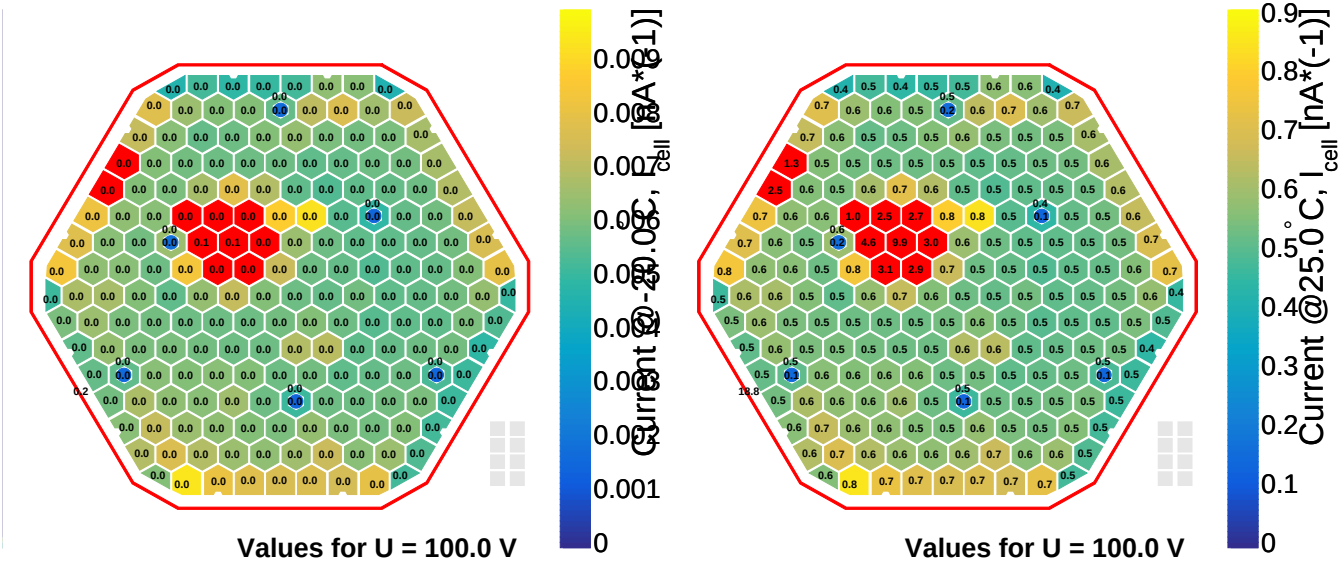


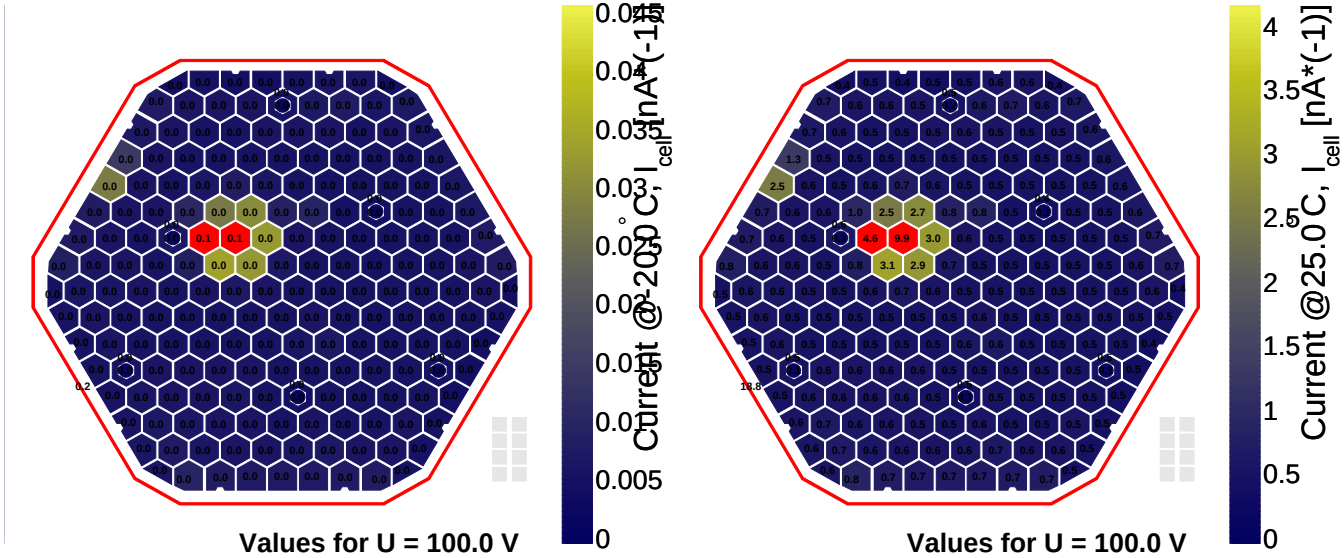




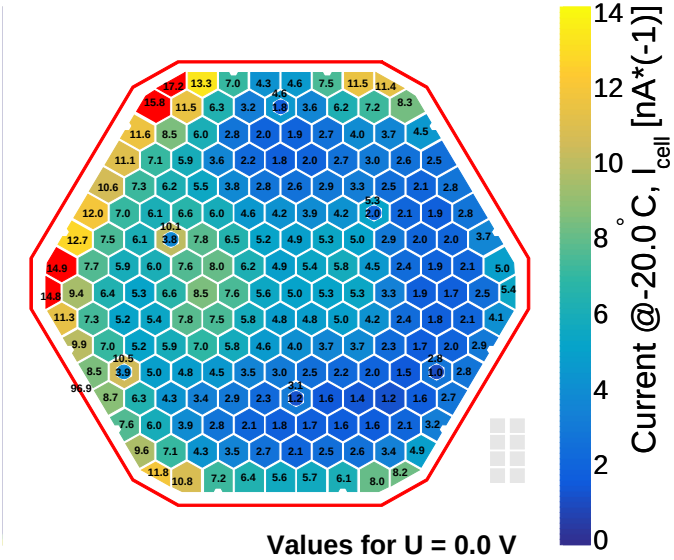


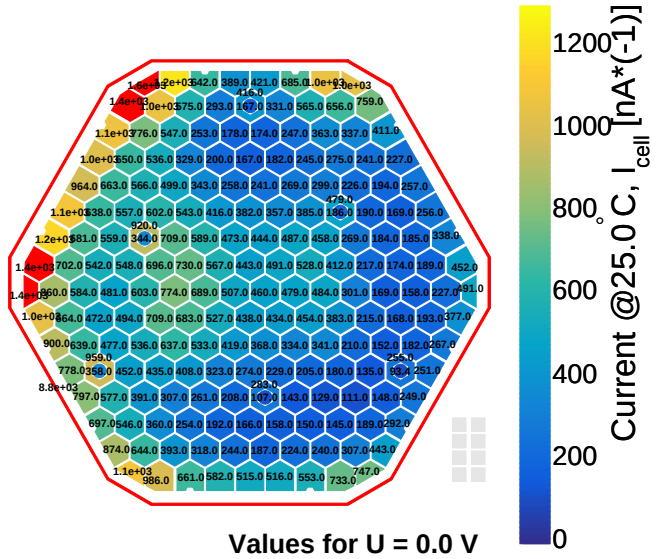
Hexplots, nominal bias voltage of 100.0 V

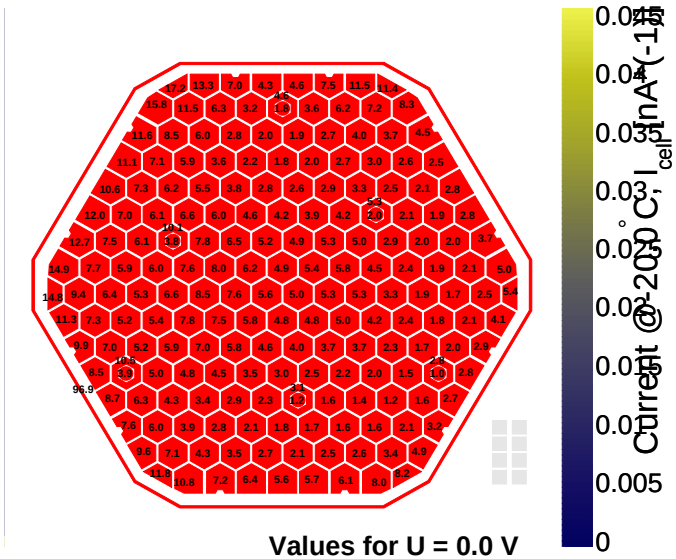


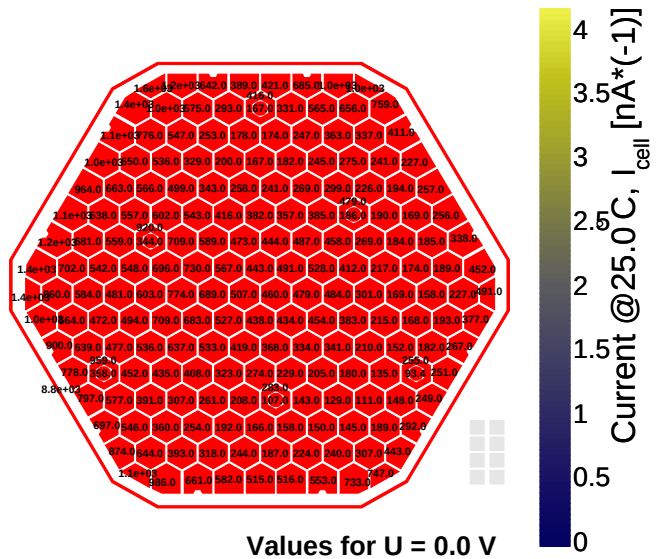


Hexplots, nominal bias voltage of 0.0 V



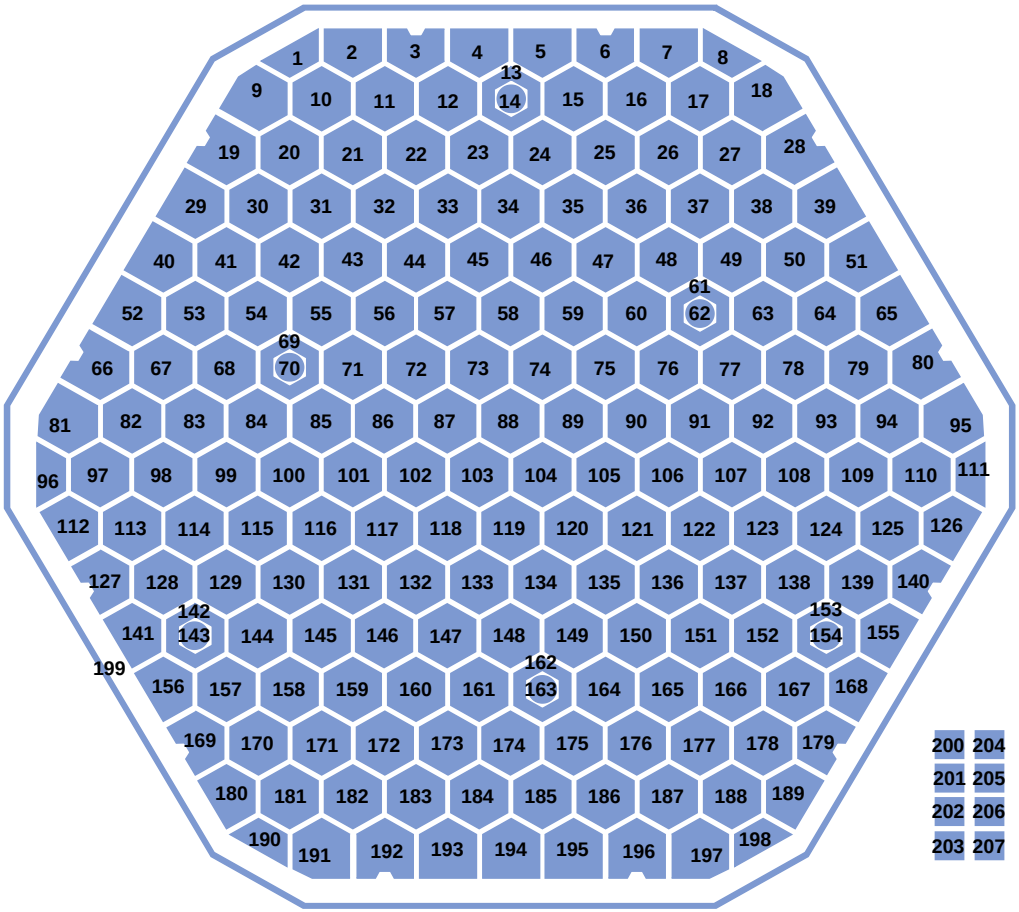






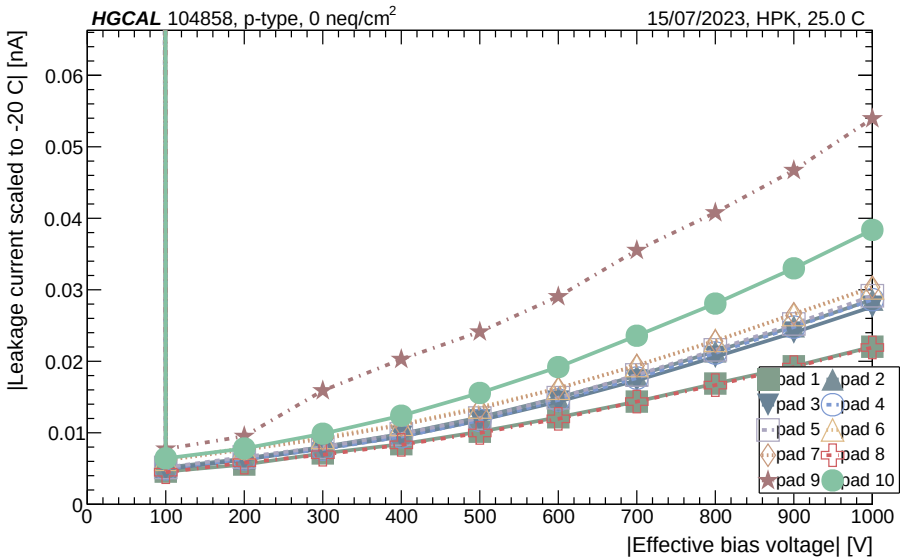
Channel mapping

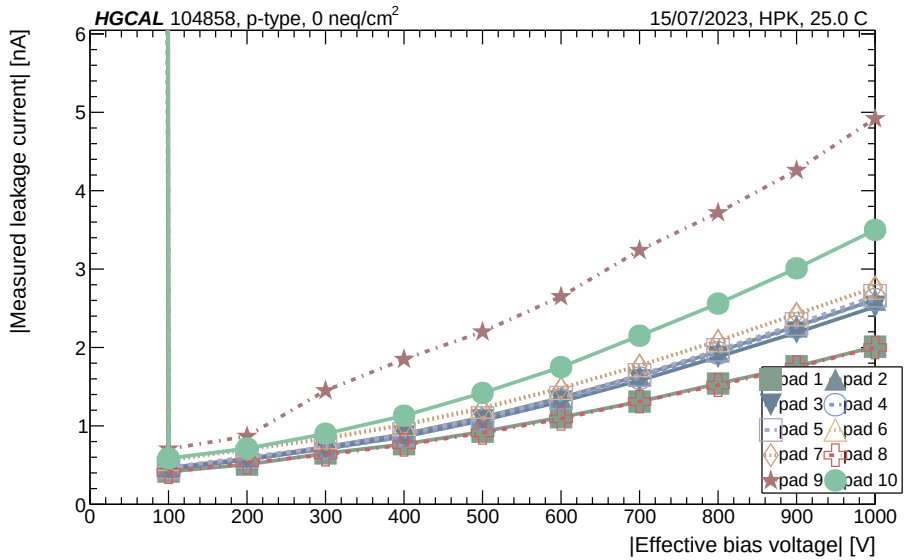
- Illustration of the channel pad numbers for the subsequent figures.



Per-cell IV curves, pads 1-10

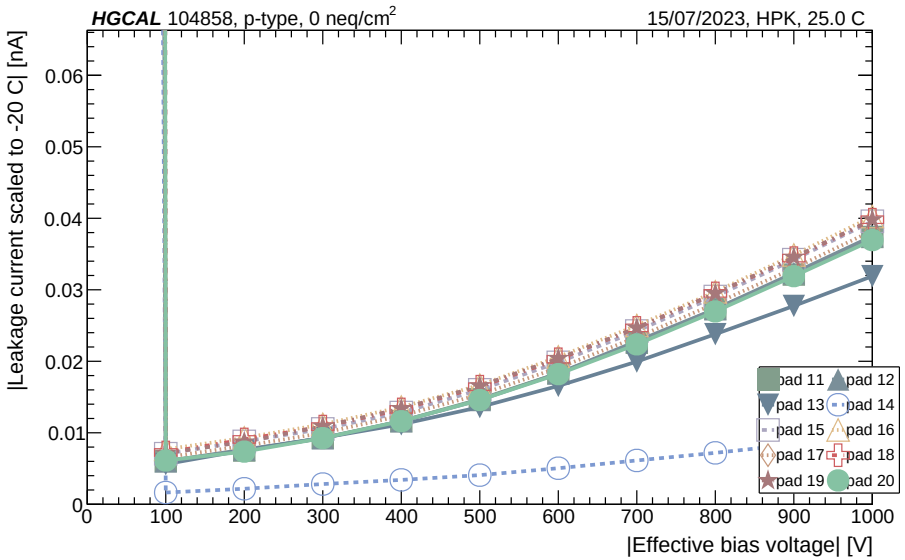
- The maximum of the y-scale is defined to be the median of all cells plus 1.5× the 68% central inter-quantile range.
- Left: Currents are normalised to a reference temperature $T_{-20} = -20°$ C, as stated in Equation 1.
- Right: Cell leakage current at 25.0° as measured, i.e. without temperature scaling.

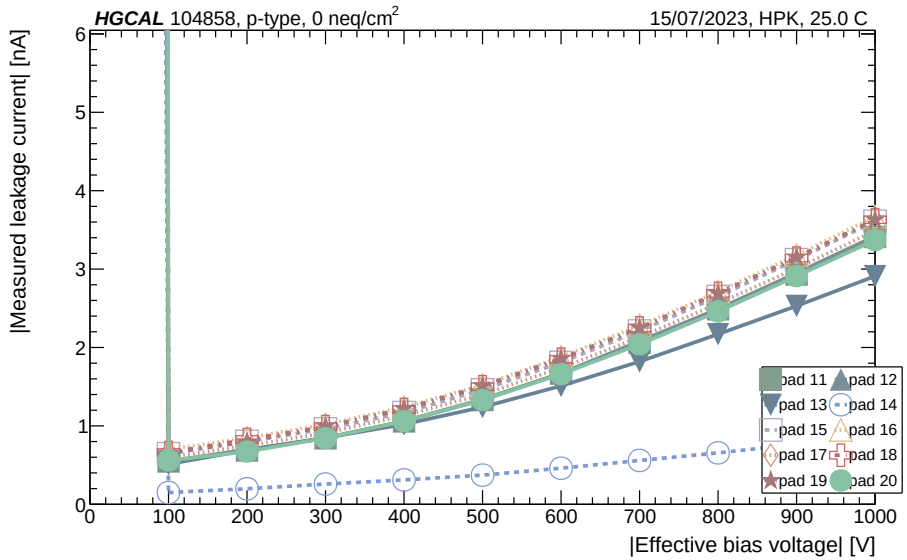




Per-cell IV curves, pads 11-20

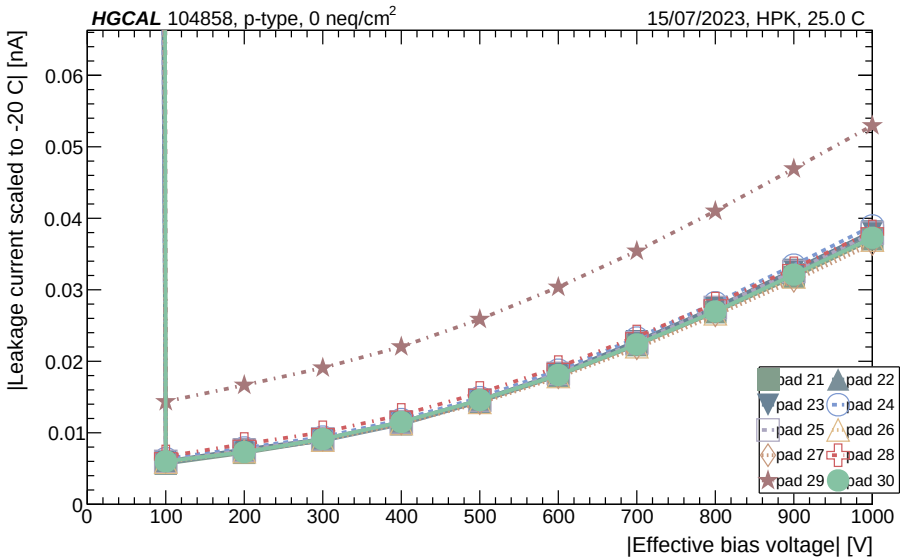
- The maximum of the y-scale is defined to be the median of all cells plus 1.5× the 68% central inter-quantile range.
- Left: Currents are normalised to a reference temperature $T_{-20} = -20°$ C, as stated in Equation 1.
- Right: Cell leakage current at 25.0° as measured, i.e. without temperature scaling.

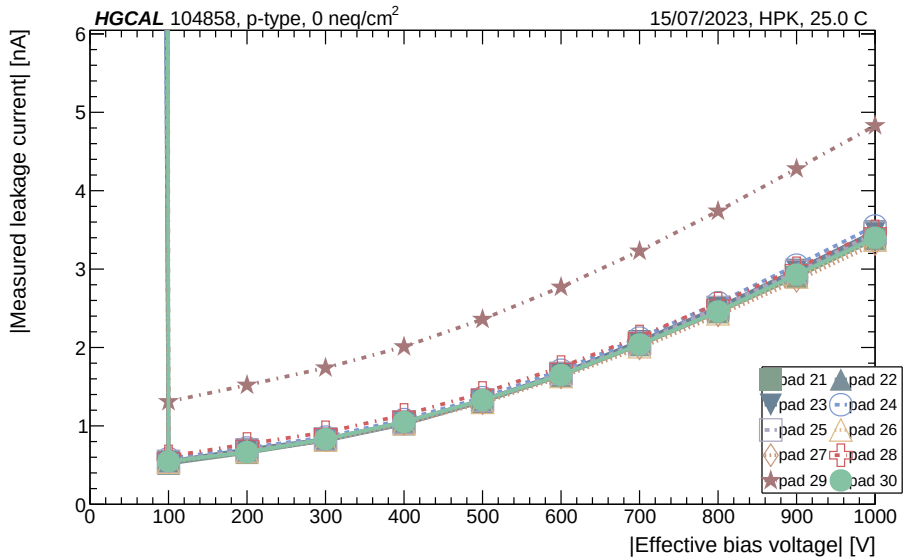




Per-cell IV curves, pads 21-30

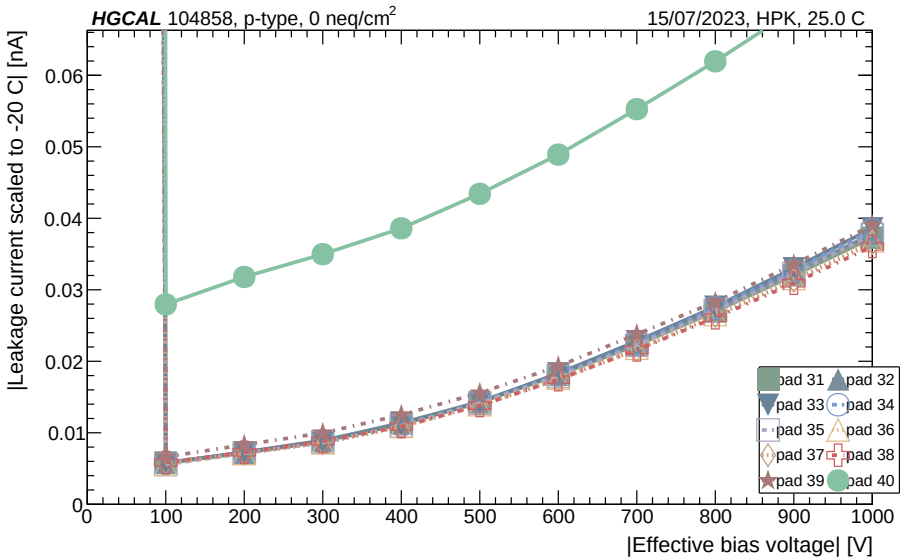
- The maximum of the y-scale is defined to be the median of all cells plus 1.5× the 68% central inter-quantile range.
- Left: Currents are normalised to a reference temperature $T_{-20} = -20°$ C, as stated in Equation 1.
- Right: Cell leakage current at 25.0° as measured, i.e. without temperature scaling.

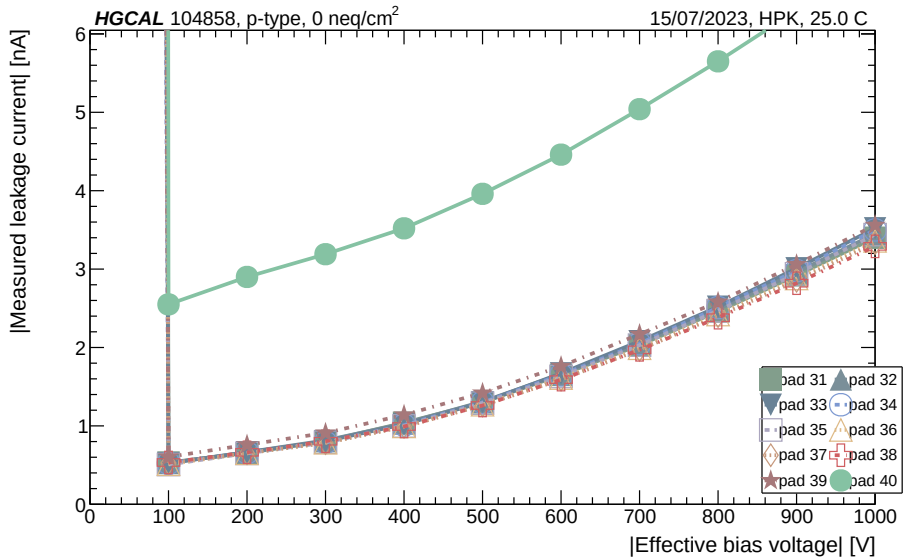




Per-cell IV curves, pads 31-40

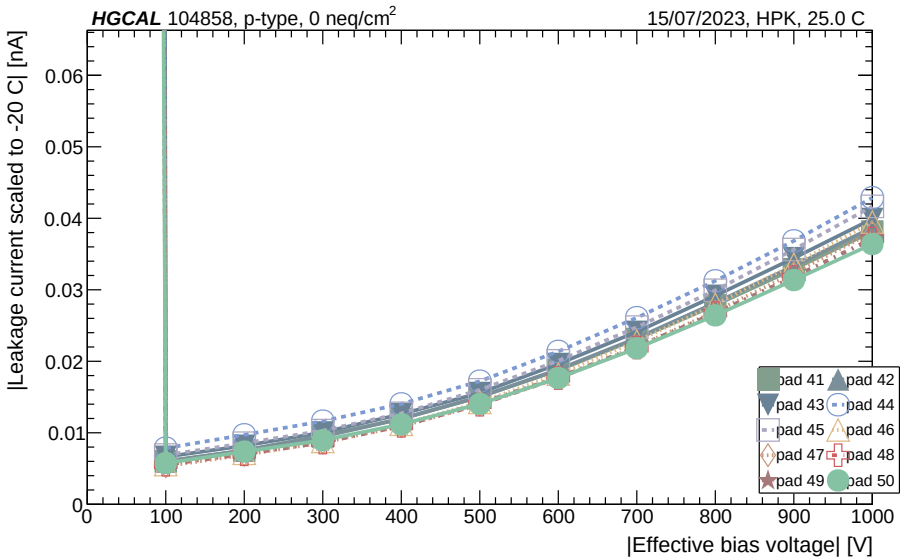
- The maximum of the y-scale is defined to be the median of all cells plus 1.5× the 68% central inter-quantile range.
- Left: Currents are normalised to a reference temperature $T_{-20} = -20°$ C, as stated in Equation 1.
- Right: Cell leakage current at 25.0° as measured, i.e. without temperature scaling.

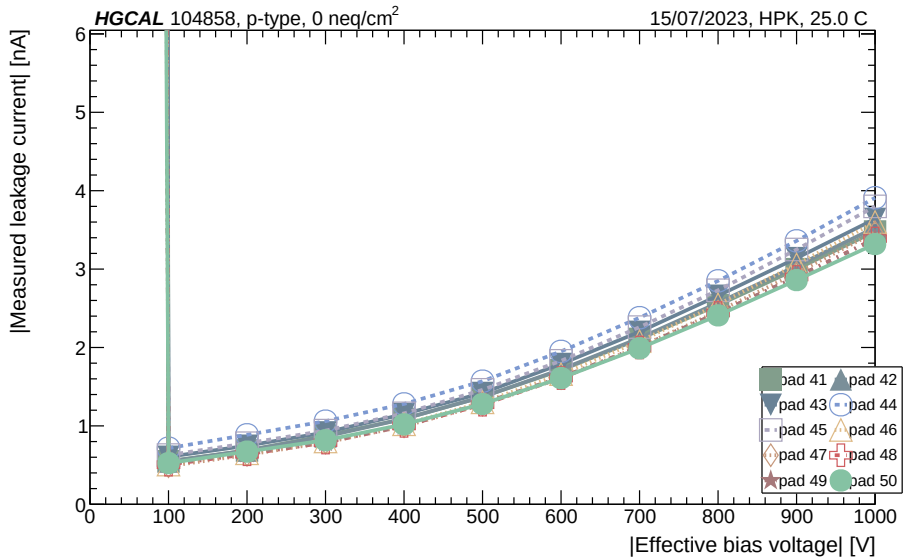




Per-cell IV curves, pads 41-50

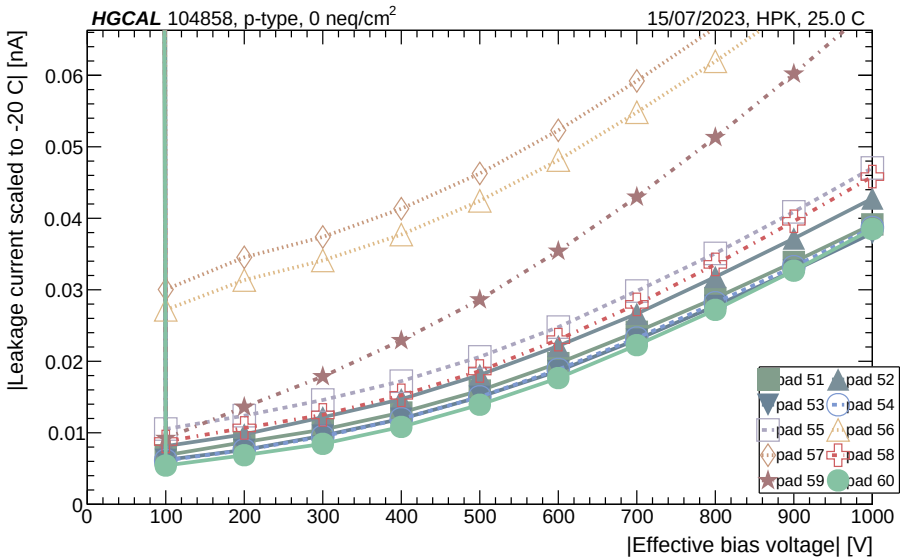
- The maximum of the y-scale is defined to be the median of all cells plus 1.5× the 68% central inter-quantile range.
- Left: Currents are normalised to a reference temperature $T_{-20} = -20°$ C, as stated in Equation 1.
- Right: Cell leakage current at 25.0° as measured, i.e. without temperature scaling.

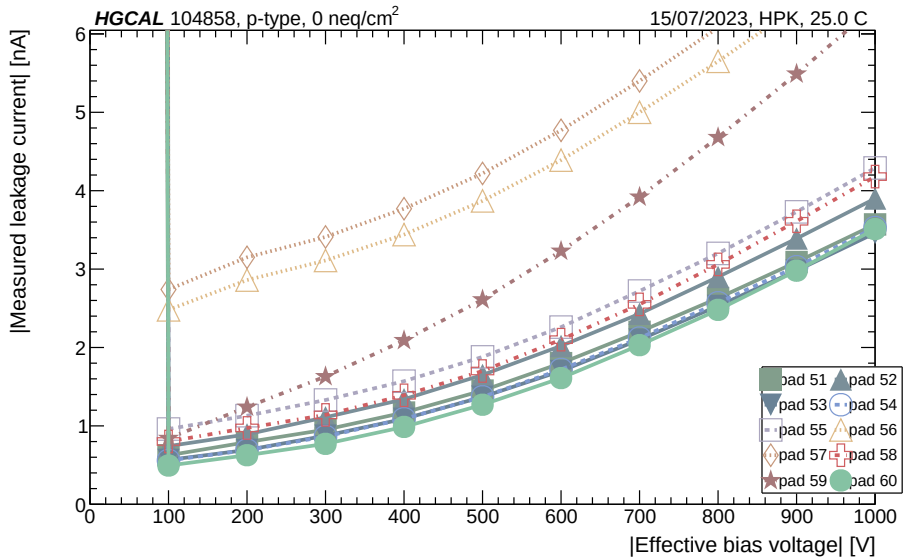




Per-cell IV curves, pads 51-60

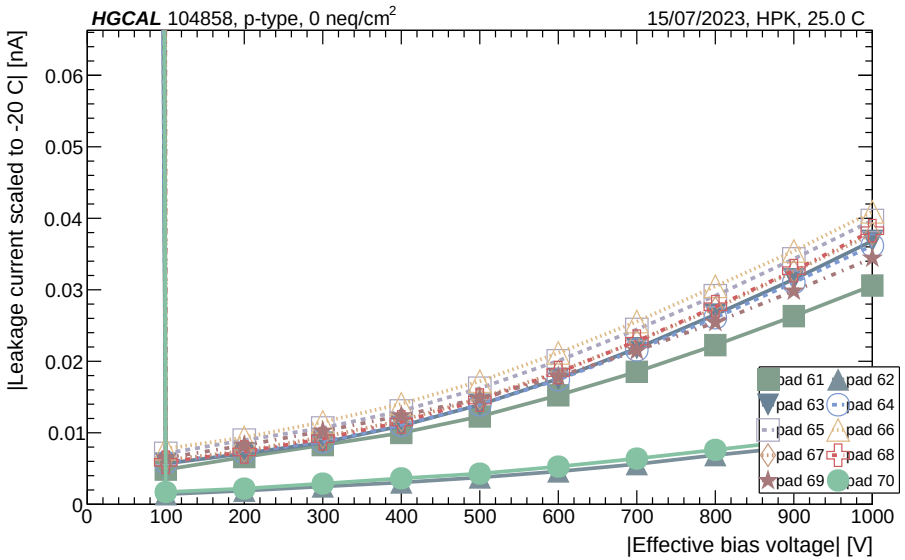
- The maximum of the y-scale is defined to be the median of all cells plus 1.5× the 68% central inter-quantile range.
- Left: Currents are normalised to a reference temperature $T_{-20} = -20°$ C, as stated in Equation 1.
- Right: Cell leakage current at 25.0° as measured, i.e. without temperature scaling.

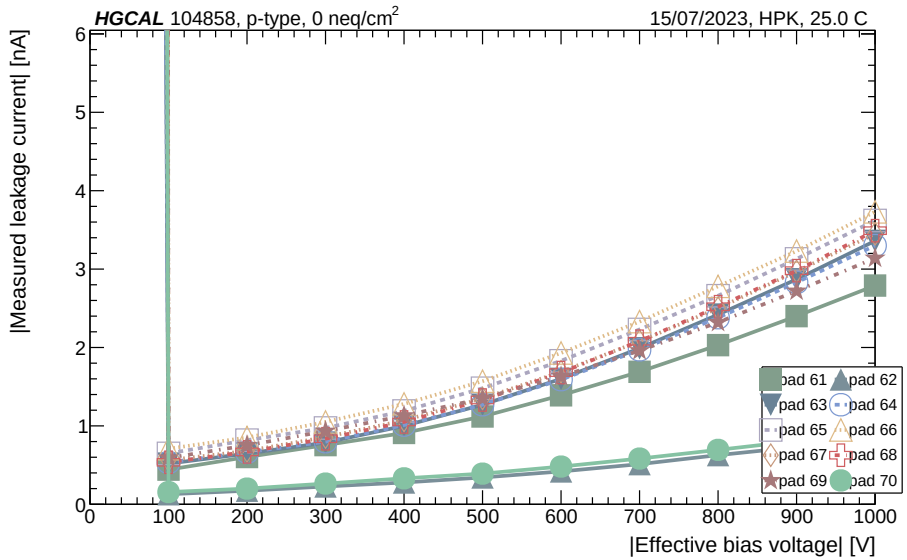




Per-cell IV curves, pads 61-70

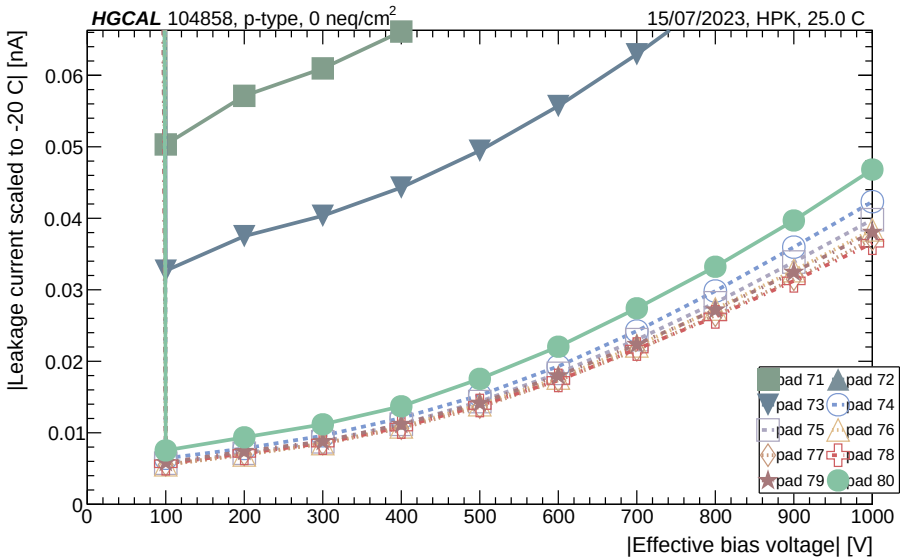
- The maximum of the y-scale is defined to be the median of all cells plus 1.5× the 68% central inter-quantile range.
- Left: Currents are normalised to a reference temperature $T_{-20} = -20°$ C, as stated in Equation 1.
- Right: Cell leakage current at 25.0° as measured, i.e. without temperature scaling.

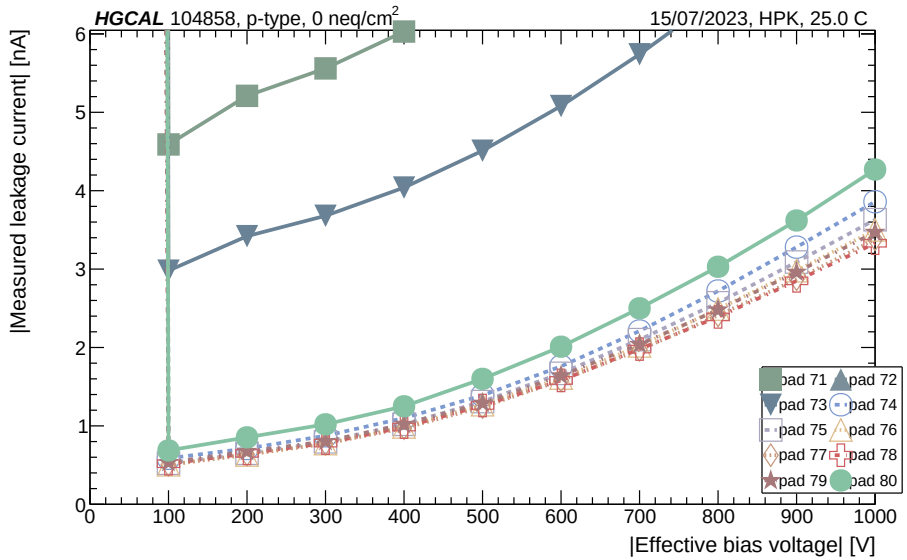




Per-cell IV curves, pads 71-80

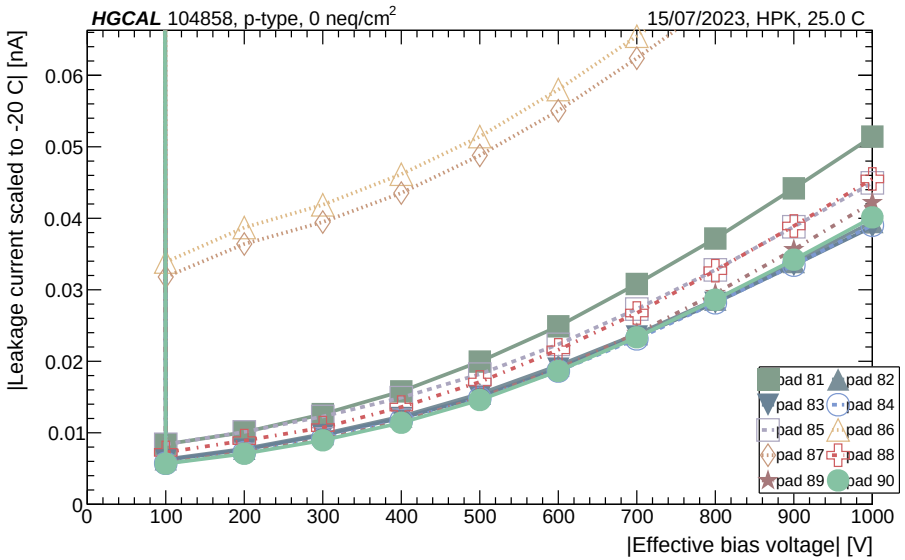
- The maximum of the y-scale is defined to be the median of all cells plus 1.5× the 68% central inter-quantile range.
- Left: Currents are normalised to a reference temperature $T_{-20} = -20°$ C, as stated in Equation 1.
- Right: Cell leakage current at 25.0° as measured, i.e. without temperature scaling.

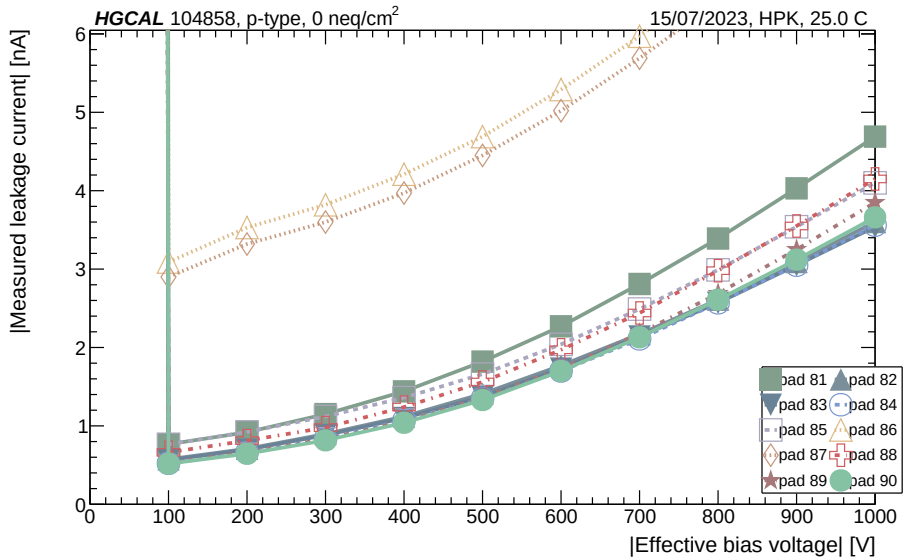




Per-cell IV curves, pads 81-90

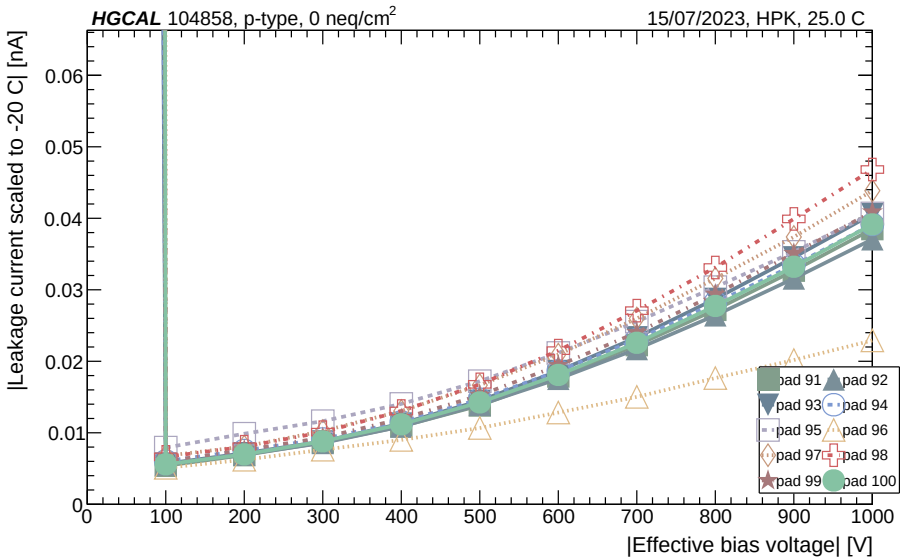
- The maximum of the y-scale is defined to be the median of all cells plus 1.5× the 68% central inter-quantile range.
- Left: Currents are normalised to a reference temperature $T_{-20} = -20°$ C, as stated in Equation 1.
- Right: Cell leakage current at 25.0° as measured, i.e. without temperature scaling.

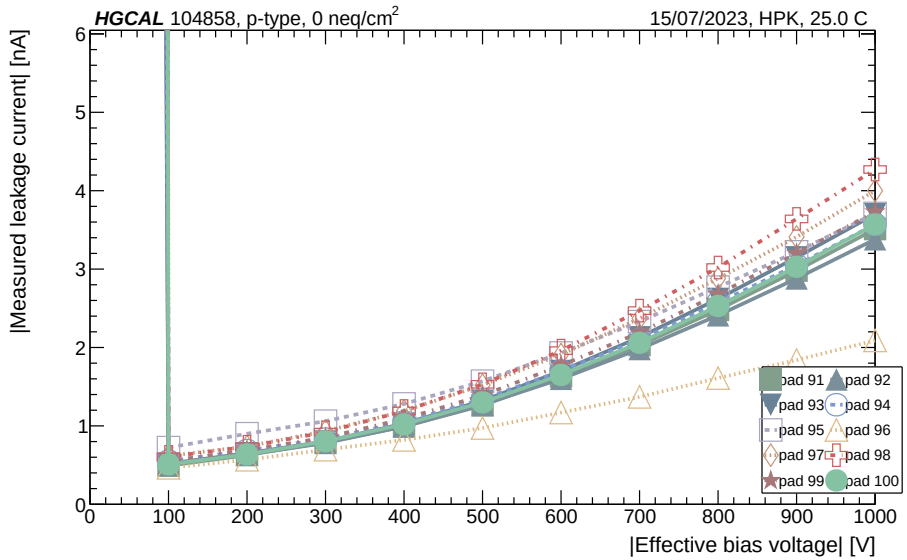




Per-cell IV curves, pads 91-100

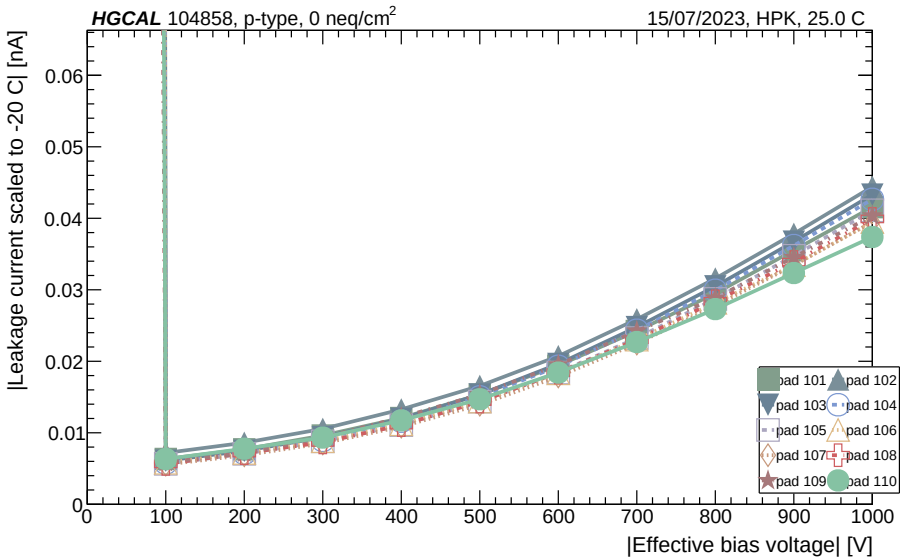
- The maximum of the y-scale is defined to be the median of all cells plus 1.5× the 68% central inter-quantile range.
- Left: Currents are normalised to a reference temperature $T_{-20} = -20°$ C, as stated in Equation 1.
- Right: Cell leakage current at 25.0° as measured, i.e. without temperature scaling.

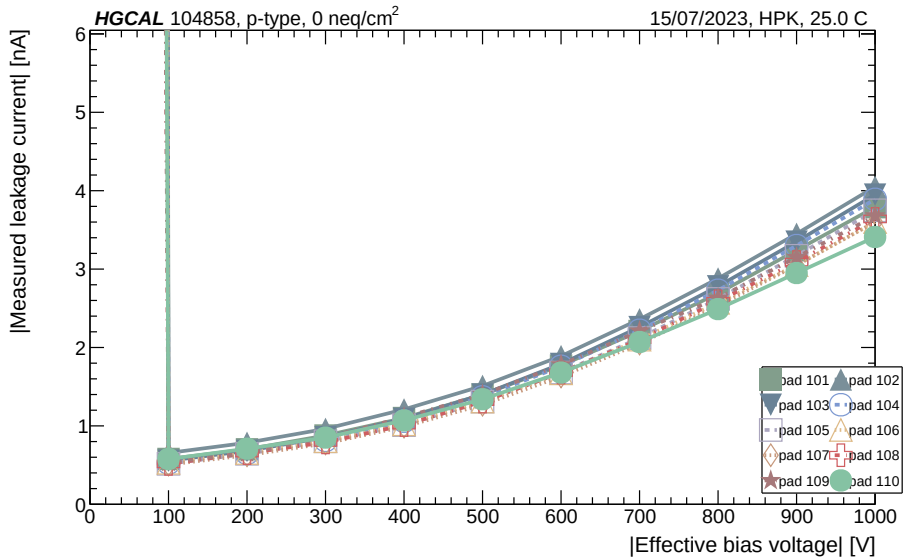




Per-cell IV curves, pads 101-110

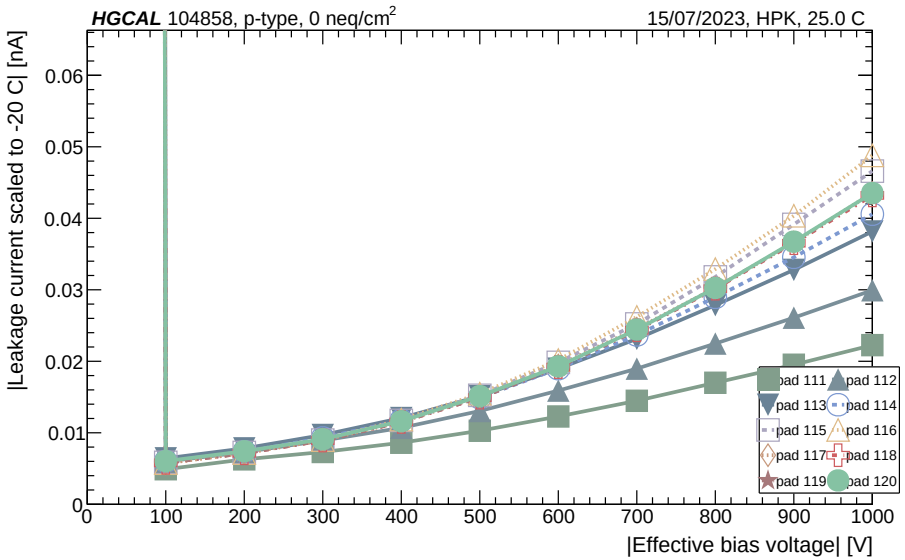
- The maximum of the y-scale is defined to be the median of all cells plus 1.5× the 68% central inter-quantile range.
- Left: Currents are normalised to a reference temperature $T_{-20} = -20^\circ$ C, as stated in Equation 1.
- Right: Cell leakage current at 25.0° as measured, i.e. without temperature scaling.

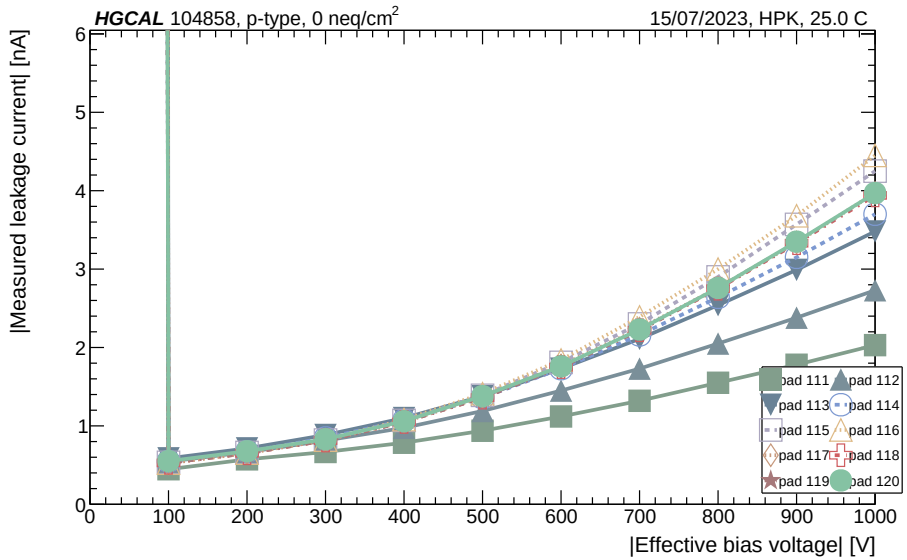




Per-cell IV curves, pads 111-120

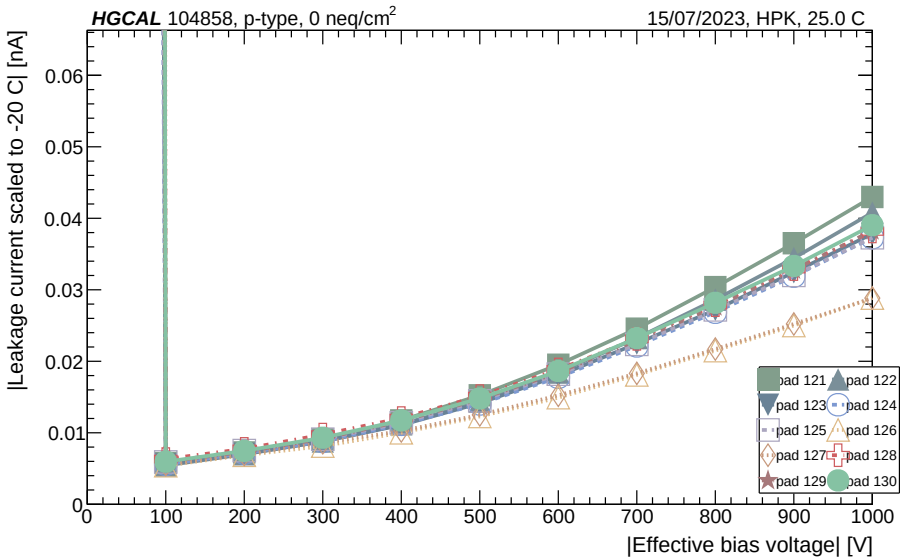
- The maximum of the y-scale is defined to be the median of all cells plus 1.5× the 68% central inter-quantile range.
- Left: Currents are normalised to a reference temperature $T_{-20} = -20^\circ$ C, as stated in Equation 1.
- Right: Cell leakage current at 25.0° as measured, i.e. without temperature scaling.

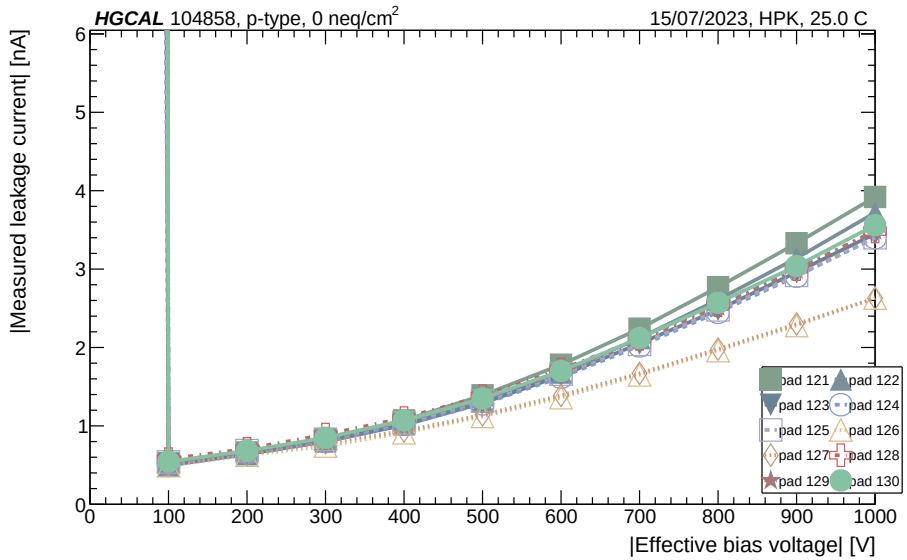




Per-cell IV curves, pads 121-130

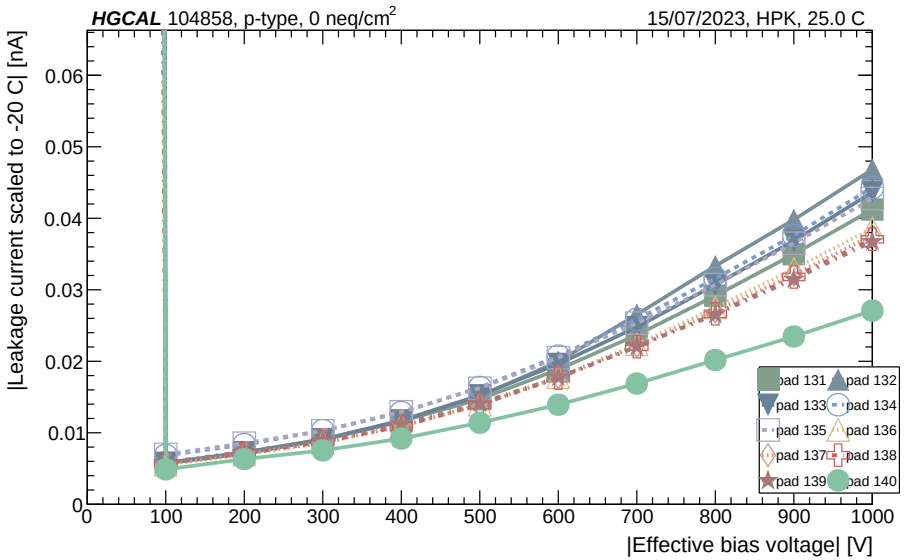
- The maximum of the y-scale is defined to be the median of all cells plus 1.5× the 68% central inter-quantile range.
- Left: Currents are normalised to a reference temperature $T_{-20} = -20^\circ$ C, as stated in Equation 1.
- Right: Cell leakage current at 25.0° as measured, i.e. without temperature scaling.

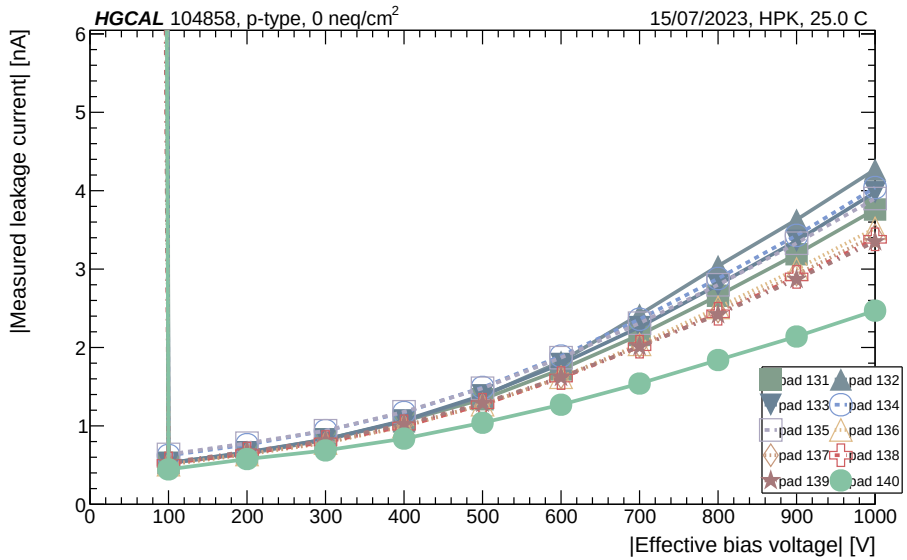




Per-cell IV curves, pads 131-140

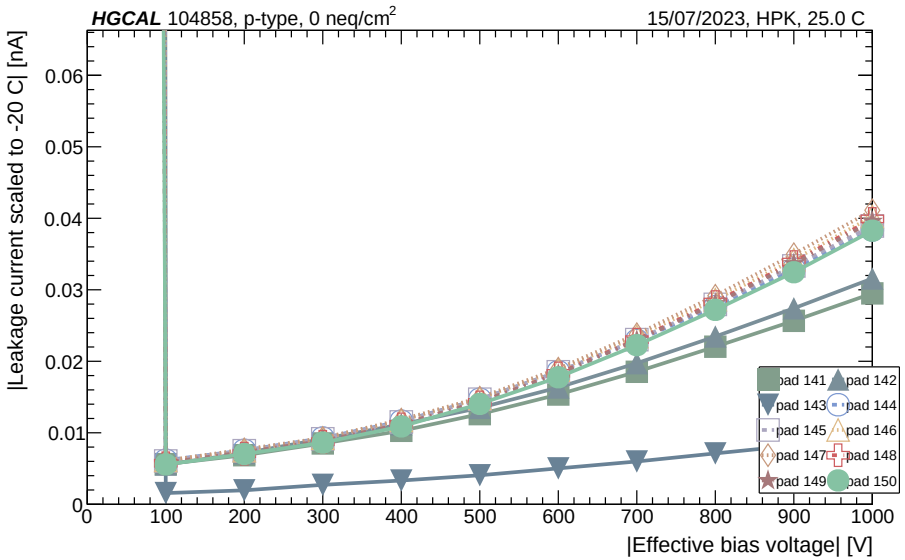
- The maximum of the y-scale is defined to be the median of all cells plus 1.5× the 68% central inter-quantile range.
- Left: Currents are normalised to a reference temperature $T_{-20} = -20^\circ$ C, as stated in Equation 1.
- Right: Cell leakage current at 25.0° as measured, i.e. without temperature scaling.

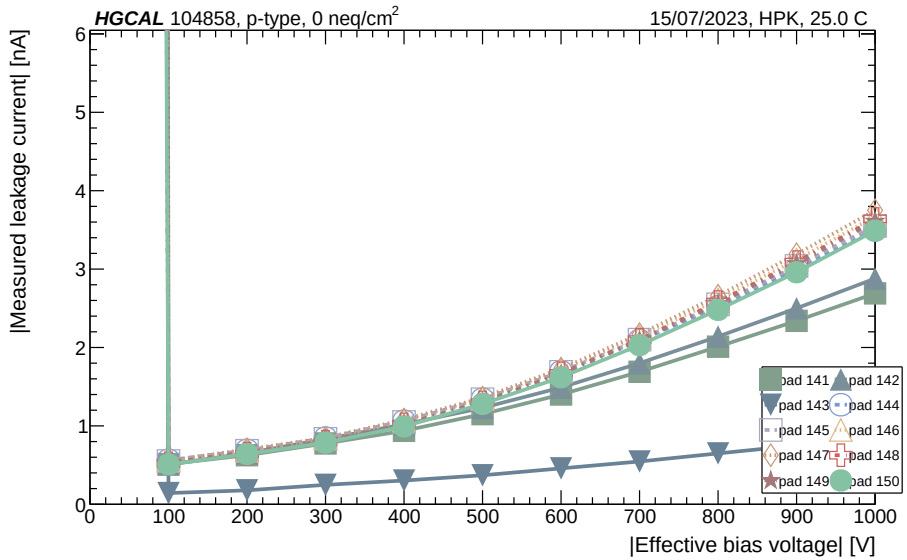




Per-cell IV curves, pads 141-150

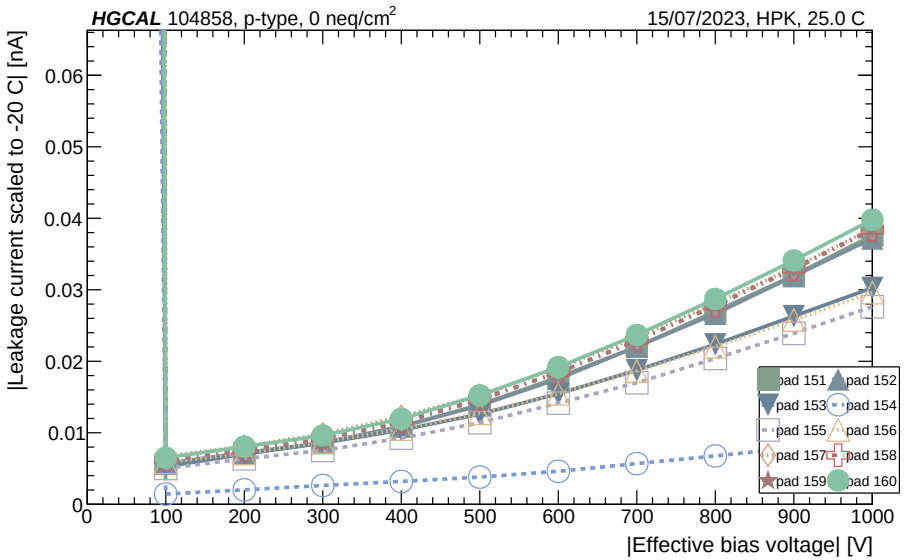
- The maximum of the y-scale is defined to be the median of all cells plus 1.5× the 68% central inter-quantile range.
- Left: Currents are normalised to a reference temperature $T_{-20} = -20^\circ$ C, as stated in Equation 1.
- Right: Cell leakage current at 25.0° as measured, i.e. without temperature scaling.

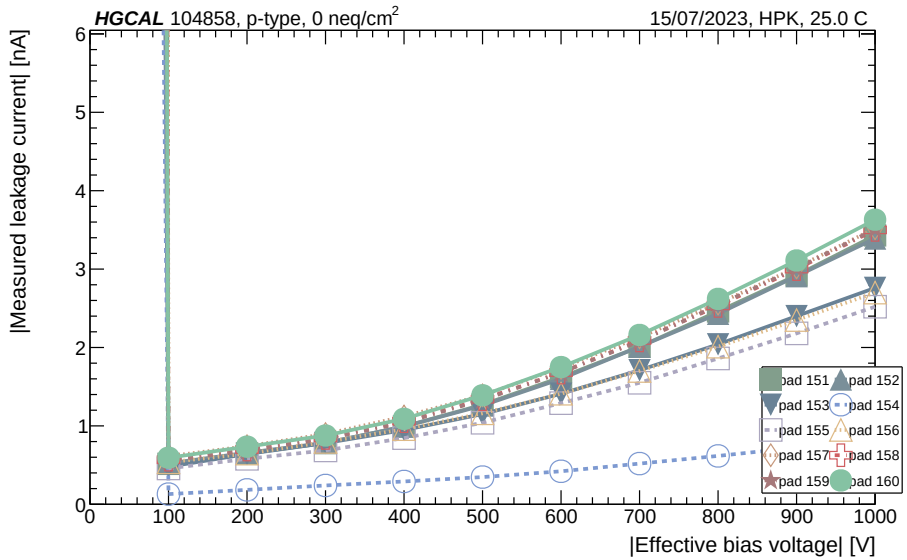




Per-cell IV curves, pads 151-160

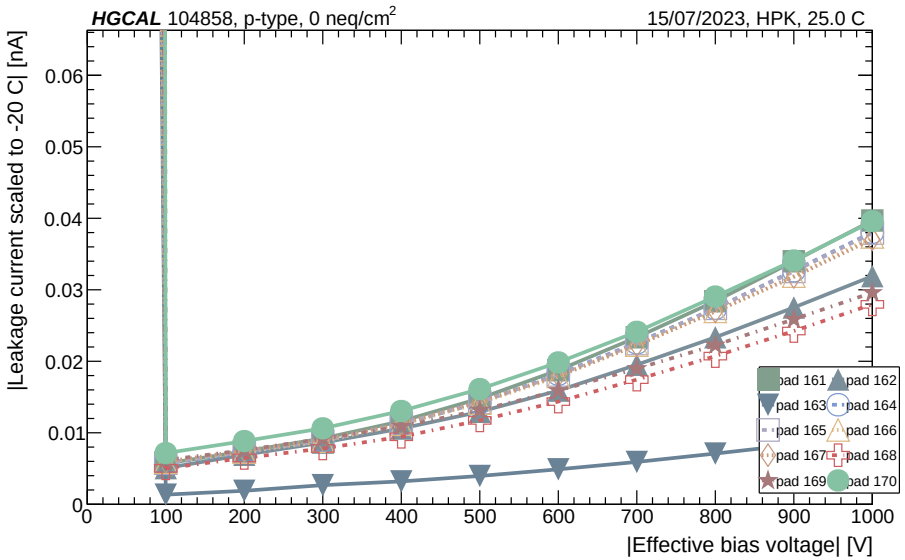
- The maximum of the y-scale is defined to be the median of all cells plus 1.5× the 68% central inter-quantile range.
- Left: Currents are normalised to a reference temperature $T_{-20} = -20°$ C, as stated in Equation 1.
- Right: Cell leakage current at 25.0° as measured, i.e. without temperature scaling.

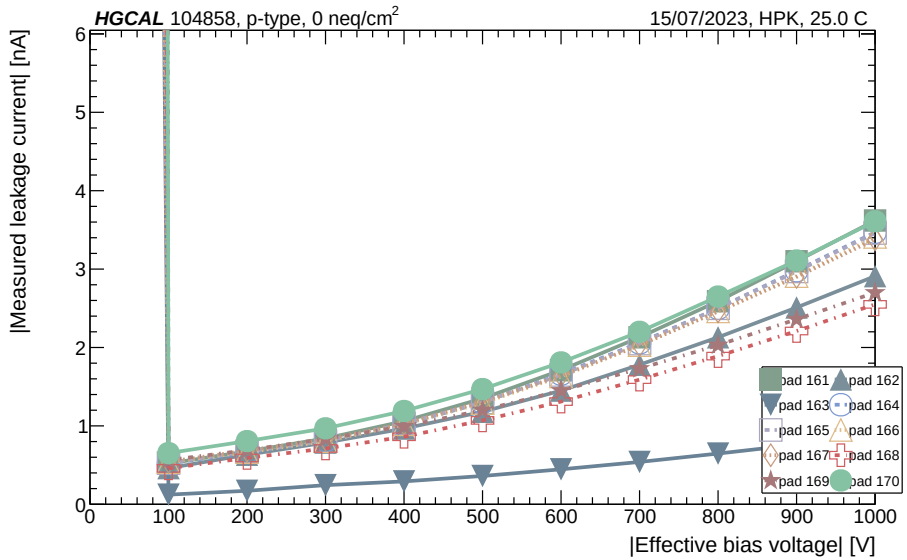




Per-cell IV curves, pads 161-170

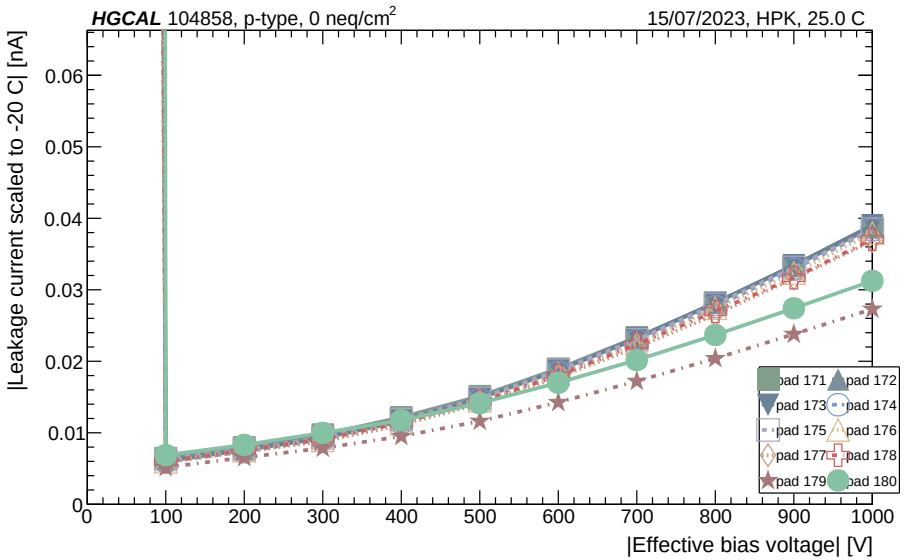
- The maximum of the y-scale is defined to be the median of all cells plus 1.5× the 68% central inter-quantile range.
- Left: Currents are normalised to a reference temperature $T_{-20} = -20^\circ$ C, as stated in Equation 1.
- Right: Cell leakage current at 25.0° as measured, i.e. without temperature scaling.

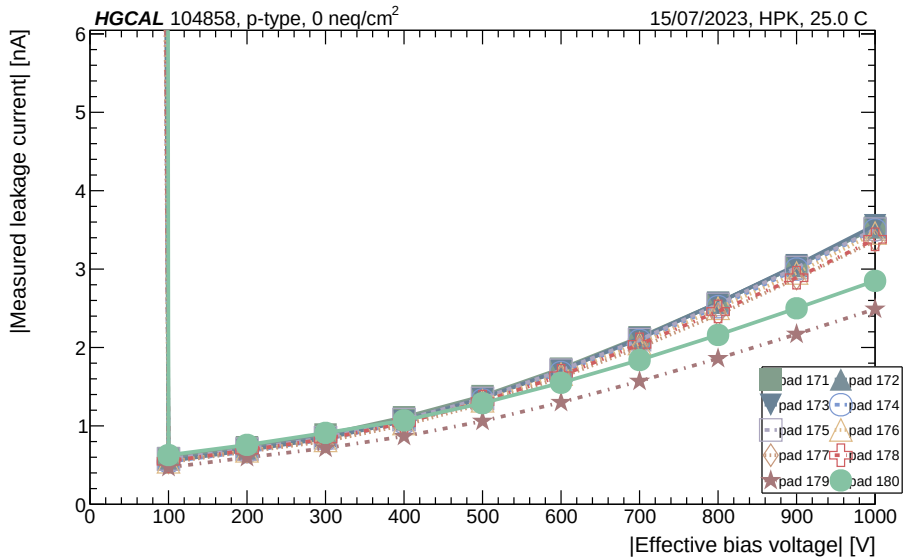




Per-cell IV curves, pads 171-180

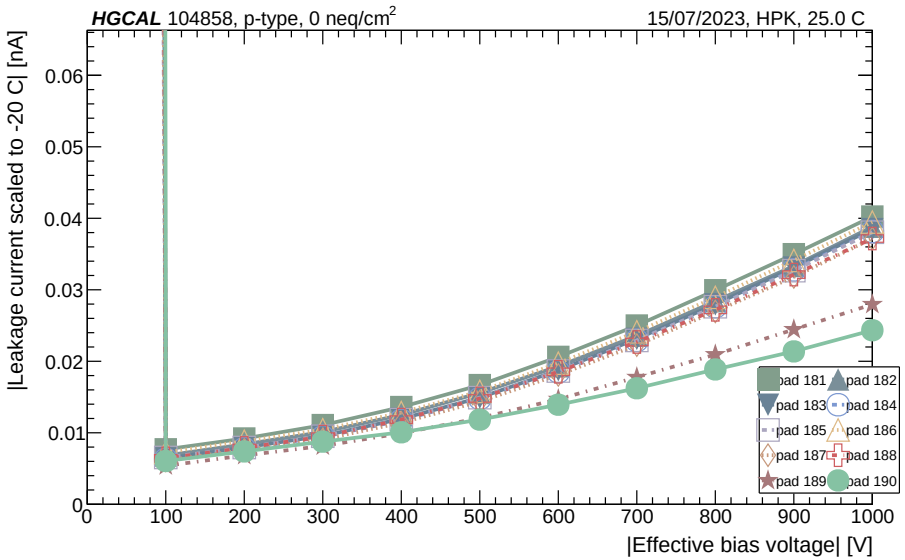
- The maximum of the y-scale is defined to be the median of all cells plus 1.5× the 68% central inter-quantile range.
- Left: Currents are normalised to a reference temperature $T_{-20} = -20°$ C, as stated in Equation 1.
- Right: Cell leakage current at 25.0° as measured, i.e. without temperature scaling.

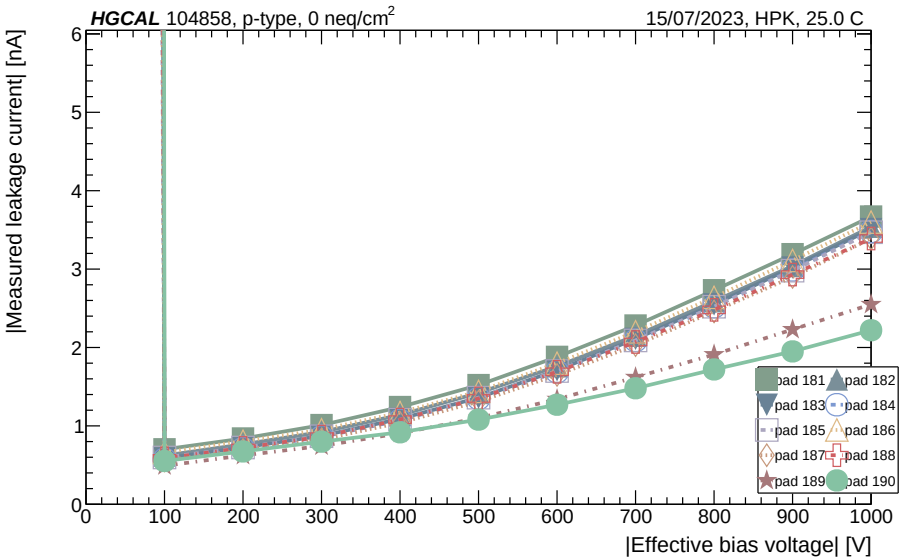




Per-cell IV curves, pads 181-190

- The maximum of the y-scale is defined to be the median of all cells plus 1.5× the 68% central inter-quantile range.
- Left: Currents are normalised to a reference temperature $T_{-20} = -20^\circ$ C, as stated in Equation 1.
- Right: Cell leakage current at 25.0° as measured, i.e. without temperature scaling.





Per-cell IV curves, pads 191-199

- The maximum of the y-scale is defined to be the median of all cells plus 1.5× the 68% central inter-quantile range.
- Left: Currents are normalised to a reference temperature $T_{-20} = -20°$ C, as stated in Equation 1.
- Right: Cell leakage current at 25.0° as measured, i.e. without temperature scaling.